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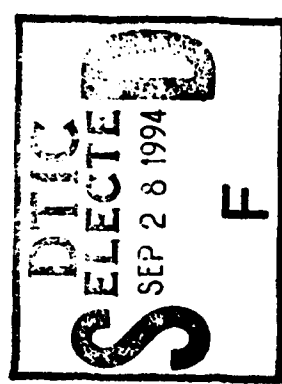
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UNITED STATES ARMY  
COMMUNICATIONS-ELECTRONICS COMMAND

AD-A284 869



FORT MONMOUTH, NEW JERSEY

ADVANCE PLANNING  
BRIEFING FOR INDUSTRY

"POWER SOURCES CHALLENGES TODAY AND TOMORROW"

SHERATON EATONTOWN HOTEL AND CONFERENCE CENTER

SEPTEMBER 13, 1994

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# UNITED STATES ARMY COMMUNICATIONS-ELECTRONICS COMMAND



FORT MONMOUTH, NEW JERSEY

## ADVANCE PLANNING BRIEFING FOR INDUSTRY

"POWER SOURCES CHALLENGES TODAY AND TOMORROW"

SHERATON EATONTOWN HOTEL AND CONFERENCE CENTER  
SEPTEMBER 13, 1994

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REPLY TO  
ATTENTION OF

DEPARTMENT OF THE ARMY  
HEADQUARTERS, US ARMY COMMUNICATIONS-ELECTRONICS COMMAND  
AND FORT MONMOUTH  
FORT MONMOUTH, NEW JERSEY 07703-5000



Office of the Commanding General

Ladies and Gentlemen:

On behalf of the Communications-Electronics Command (CECOM), I am pleased to present these proceedings of the "Power Sources Challenges Today and Tomorrow" Advance Planning Briefing for Industry (APBI). The objective of this APBI is to ensure a mutual understanding of our goals and continuing efforts in the power sources arena.

Due to today's limited resources, Government and Industry must continue to communicate and work together as a team to ensure state-of-the-art power sources are provided to our soldiers in the most efficient and cost effective manner.

I welcome your participation in our APBI program.

Sincerely,

Otto J. Guenther  
Major General, U.S. Army  
Commanding

## **NOTICE**

**This publication contains the briefings presented during this Advance Planning Briefing for Industry (APBI). Following the APBI, you may obtain a Proceedings Book for a minimum fee, by contacting the Defense Technical Information Center (DTIC). The telephone number is (800) 225-3842 (Option 5).**

**We hope that the above publication proves beneficial to your long-range planning efforts. If you have any additional questions and/or suggestions, please contact the Program Analysis and Evaluation Directorate, AMSEL-PE-OD, ATTN: Mari Aufseeser, (908) 532-5054.**

# **DISCLAIMER**

The use of trade names in this report does not constitute official endorsement of any products. This report may not be cited for purpose of advertisement.

The information provided is accurate as of the time of publication, and may be subject to change.

**THE OVERALL CLASSIFICATION  
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ADVANCE PLANNING BRIEFING FOR INDUSTRY

SEPTEMBER 13, 1994  
SHERATON EATONTOWN HOTEL AND CONFERENCE CENTER  
EATONTOWN, NEW JERSEY

MEETING CHAIRMAN  
MR. KENNETH M. MORGAN  
DIRECTOR, SYSTEMS MANAGEMENT, CECOM

AGENDA

TUESDAY, SEPTEMBER 13, 1994

0700      REGISTRATION - SHERATON

0815      INTRODUCTORY REMARKS  
          Mr. Kenneth M. Morgan  
          Director, Systems Management, CECOM

0825      WELCOMING REMARKS  
          Mr. Colin F. MacDonnell, Jr.  
          Director, C3I Logistics and Readiness Center, CECOM

0835      KEYNOTE ADDRESS  
          Mr. James B. Emahiser  
          Assistant Deputy Chief of Staff for Logistics  
          U.S. Army Materiel Command (AMC)

0905      U.S. ARMY TRAINING AND DOCTRINE COMMAND (TRADOC)  
          FUTURE NEEDS/REQUIREMENTS

          BATTERY REQUIREMENTS/MODERNIZATION STRATEGY  
          CW2 Kenneth Sanborn  
          Technology Modernization Office  
          U.S. Army Combined Arms Support Command (CASCOM)

0930      QUESTION AND ANSWER PERIOD

0940      BREAK

1000      U.S. ARMY RESEARCH LABORATORY (ARL)  
          POWER REQUIREMENTS

          PORTABLE POWER SOURCES  
          Dr. Robert P. Hamlen  
          Electronics and Power Sources Directorate, ARL

1035      POWER EFFICIENT ELECTRONICS  
          Mr. Robert Heuner  
          Electronics and Power Sources Directorate, ARL



1055 U.S. ARMY COMMUNICATIONS-ELECTRONICS COMMAND (CECOM)  
AMC BATTERY FOCAL POINT

BATTERY PROGRAM  
Mr. Richard Rizzo  
AMC Battery Focal Point  
Systems Management Directorate, CECOM

1130 DIRECT VENDOR DELIVERY  
Mr. Robert Pearson  
Materiel Management Directorate, CECOM

1140 QUESTION AND ANSWER PERIOD

1150 LUNCH

1315 U.S. ARMY SIMULATION, TRAINING AND INSTRUMENTATION  
COMMAND (STRICOM)  
FUTURE EFFORTS

BATTERY POWER FOR MANWORN PERSONNEL DETECTION DEVICE  
TRAINING SYSTEM  
Mr. Steve Milburn  
Deputy Product Manager for Combat Support Training  
Devices, STRICOM

1350 QUESTION AND ANSWER PERIOD

1400 BREAK

1420 U.S. ARMY TANK-AUTOMOTIVE AND ARMAMENTS COMMAND  
(TACOM)  
BATTERY PROGRAM

POWER AND ENERGY STORAGE REQUIREMENTS FOR  
MILITARY VEHICLES  
Mr. John F. Bush  
U.S. Army Tank-Automotive Research, Development and  
Engineering Center  
TACOM

1440 FUZE POWER SUPPLY REQUIREMENTS  
Mr. Alan C. Reiter  
Armament Research, Development and Engineering Center  
TACOM

1505 SMART MUNITIONS BATTERY REQUIREMENTS  
Dr. Clifford D. Shook  
Armament Research, Development and Engineering Center  
TACOM

1535 QUESTION AND ANSWER PERIOD

1545 CLOSING REMARKS  
Mr. Kenneth M. Morgan  
Director, Systems Management, CECOM

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# **WELCOMING REMARKS**

**Mr. Colin F. MacDonnell, Jr.**

**Director**

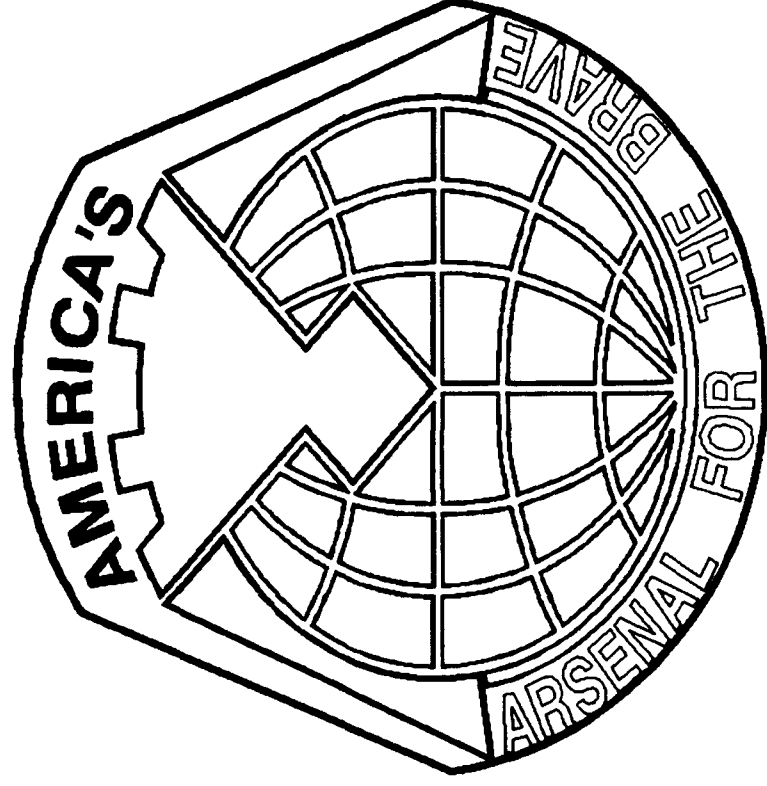
**C3I Logistics and Readiness Center**

**CECOM**

# NOTES

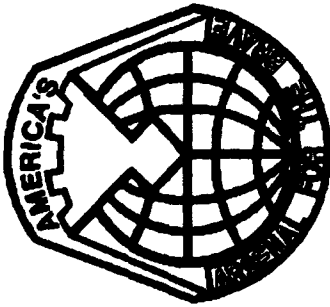
# **KEYNOTE ADDRESS**

**Mr. James B. Emahiser  
Assistant  
Deputy Chief of Staff  
for Logistics  
AMC**



**MR. JAMES B. EMAHISER**  
**US ARMY MATERIEL COMMAND**  
**ASSISTANT DEPUTY CHIEF OF STAFF**  
**FOR LOGISTICS**

**UNCLASSIFIED**



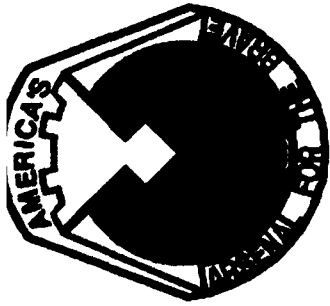
# OUTLINE

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- **OVERVIEW OF AMC**
  - \* **WHO IS AMC?**
  - \* **AMC'S VISION**
  - \* **ACHIEVING THE VISION**
- **POWER SOURCES**
  - \* **CONCERNS**
  - \* **CHALLENGES**
  - \* **INITIATIVES**



# A COMMON OBJECTIVE

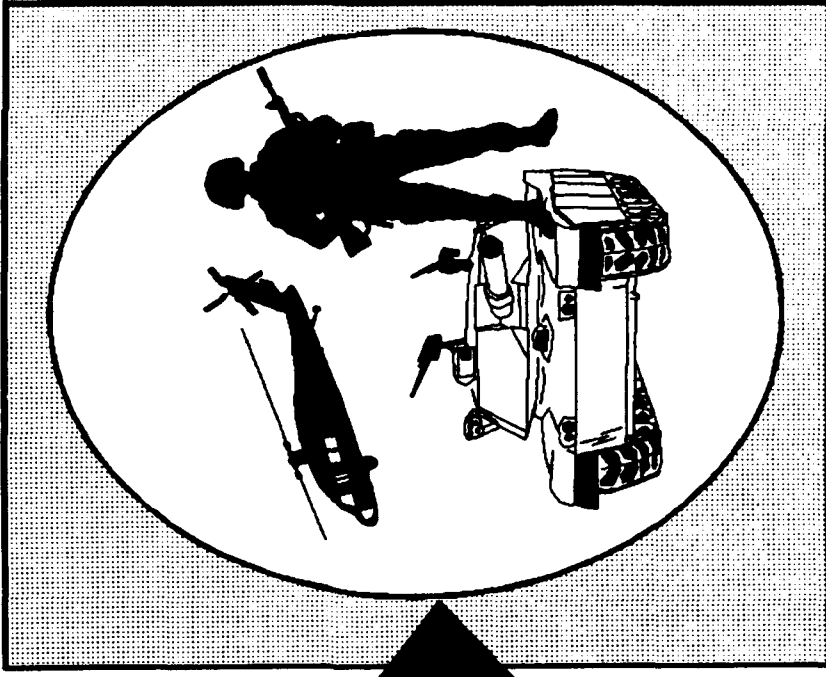
## THE ARMY VISION

AMERICA'S ARMY, TRAINED AND READY, A STRATEGIC FORCE, SERVING THE NATION HOME AND ABROAD, CAPABLE OF DECISIVE VICTORY INTO THE 21ST CENTURY

## AMC'S STRATEGIC VISION

THE LEADER IN EQUIPPING AND SUSTAINING AMERICA'S ARMY THROUGH SUPERIOR TECHNOLOGY AND RESPONSIVE SUPPORT, ASSURING WORLD WIDE POWER PROJECTION AND DECISIVE VICTORY.

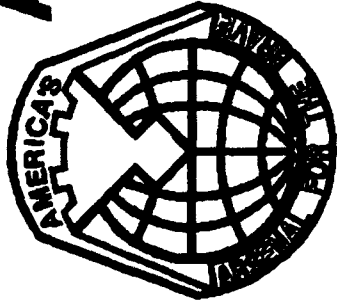
## STRATEGIC FORCE



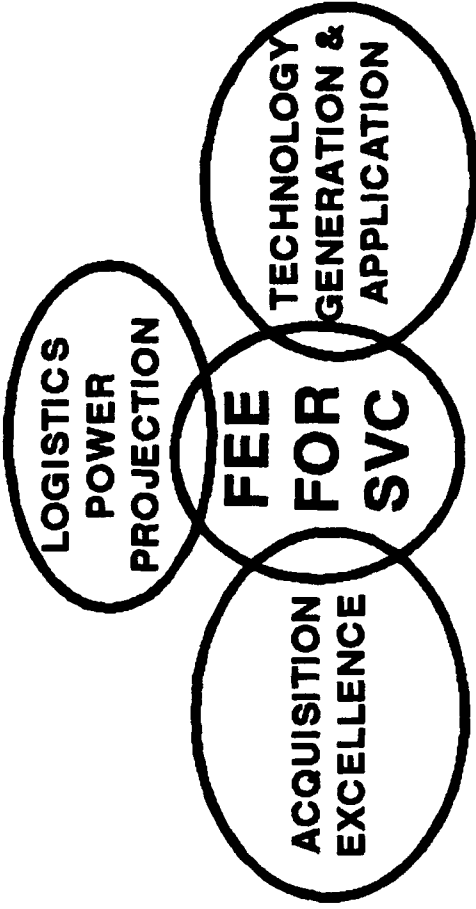
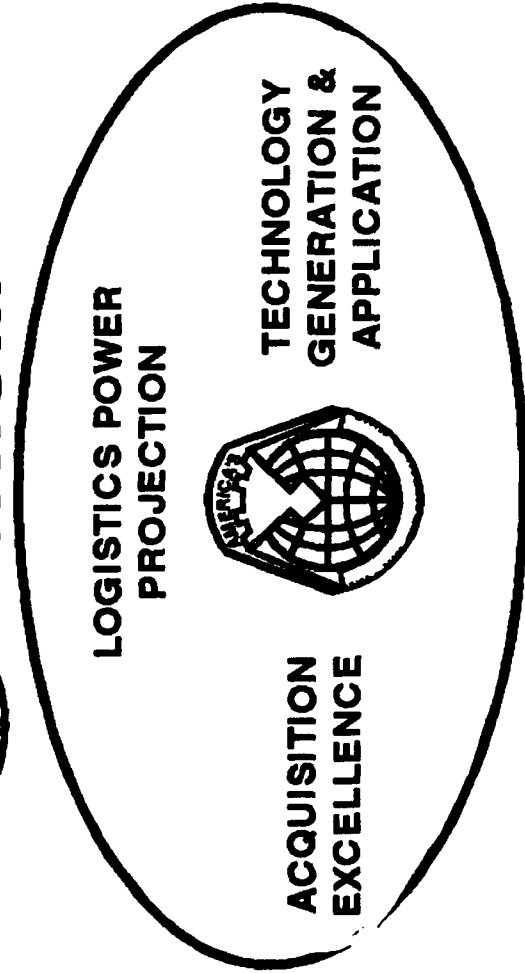
**DECISIVE VICTORY**  
**ALL THAT WE DO MUST BE DRIVEN BY THIS**



# AMC'S CORE COMPETENCIES -- A POWERFUL SYNERGY



**THIS... NOT THIS...**



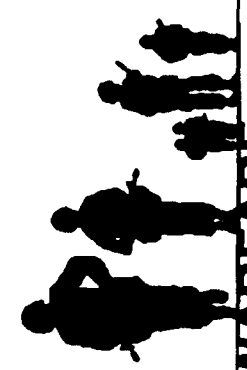
**AMC'S  
CORE  
COMPETENCIES**

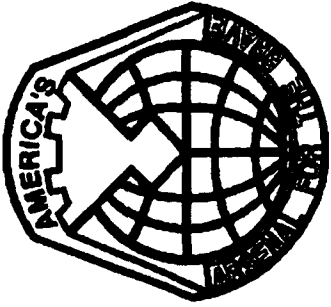
**A POWERFUL SYNERGY THAT...**

- PROVIDES SIGNIFICANT CONTRIBUTION TO THE ARMY
- CANNOT BE IMITATED OR DUPLICATED
- WITHOUT PRESENTS UNACCEPTABLE RISK TO THE ARMY

**SUPPORTING  
AMERICA'S ARMY**

**LAND WARFARE  
DOMINANCE**



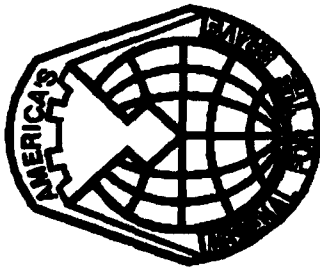


# **AMC'S MISSION**

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- ★ **EQUIP AND SUSTAIN A TRAINED  
READY ARMY**
- ★ **CONVERT USER'S REQUIREMENTS  
INTO WEAPON SYSTEMS**
- ★ **DEFINE, DEVELOP AND ACQUIRE  
SUPERIOR TECHNOLOGIES**
- ★ **DEVELOP AND MANAGE THE ARMY'S  
INDUSTRIAL PREPAREDNESS  
PROGRAM**

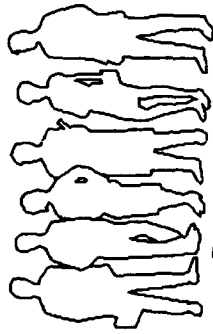


# AMC IS ...

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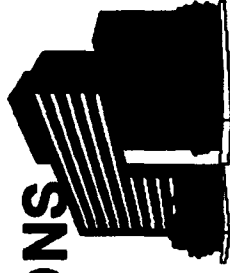
## PEOPLE



**78,285 CIVILIANS**  
**6,707 MILITARY**

## 355 LOCATIONS

**66 INSTALLATIONS**  
**40 STATES**  
**6 COUNTRIES**



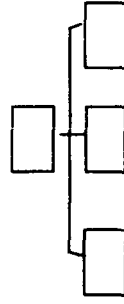
## 105 ORGANIZATIONS

**ARSENALS**

**DEPOTS**

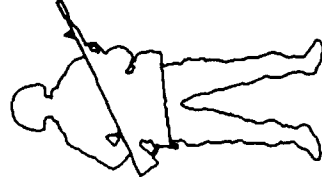
**LABORATORIES**

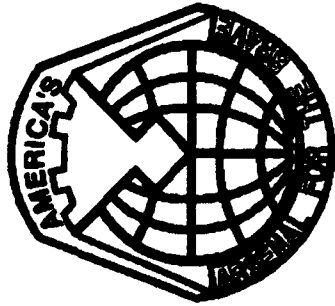
**AMMO PLANTS**



## WITH TROOPS

**1,141 PEOPLE**  
**55 OFFICES**

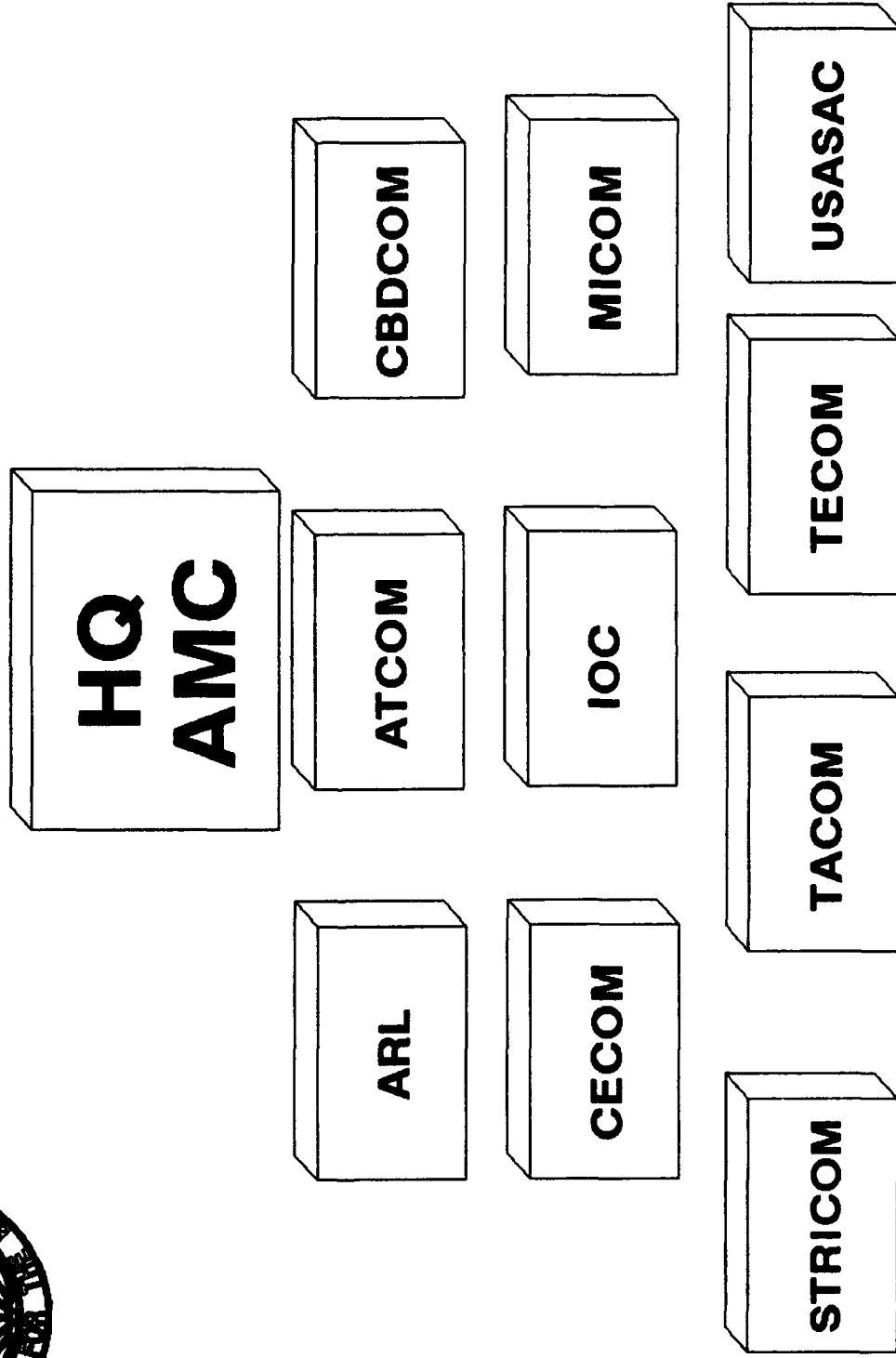


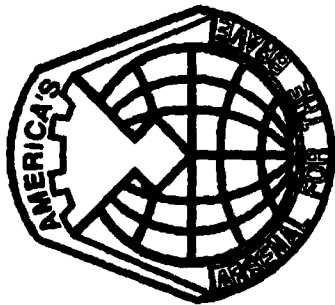


# AMC ORGANIZATION

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# AMC LOCATIONS

CBD COM TACOM

IOC

AMC  
EUROPE

CECOM

ARL

TECOM

HQ AMC  
USASAC

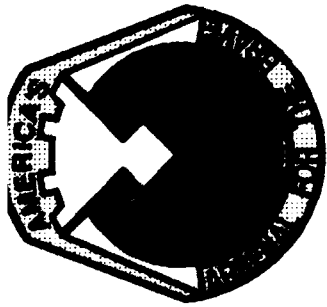
AMC  
SA

MICOM

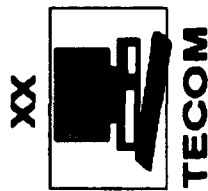
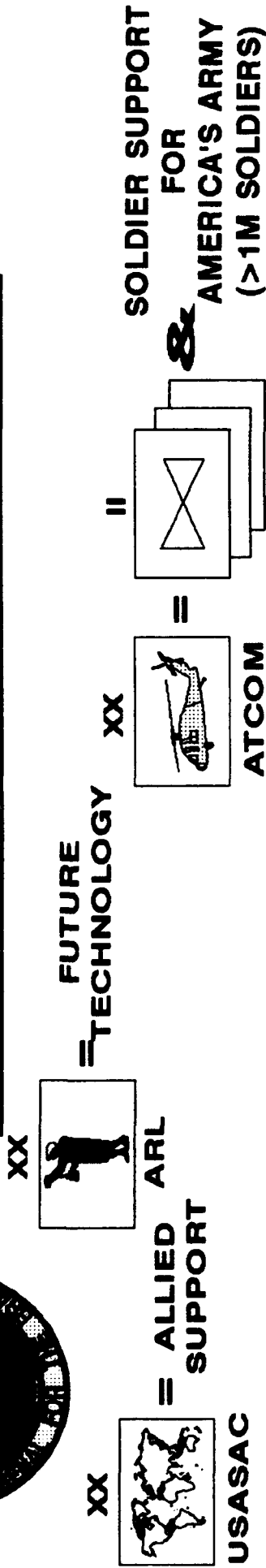
STRICOM

ATCOM

AMC  
FAR EAST



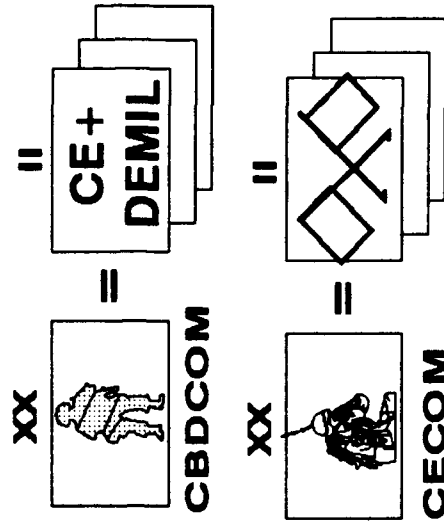
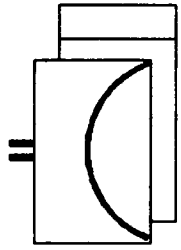
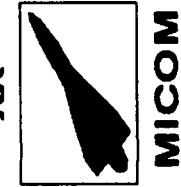
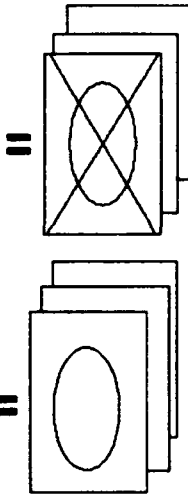
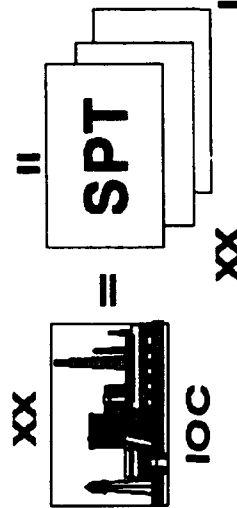
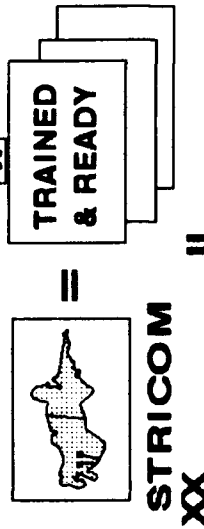
# WHAT AMC DRIVES IN THE ARMY'S TABLE

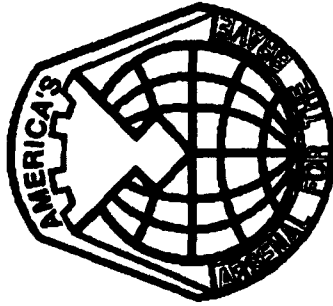


USING THE SYNERGY PROVIDED BY ITS CORE COMPETENCIES, **AMC** PROVIDES 'LIFE CYCLE MANAGEMENT' FOR ALL THE ARMY'S WEAPONS SYSTEMS ORIENTED TO 'PROMPT AND SUSTAINED LAND COMBAT'

BEST POSSIBLE WEAPONS SYSTEM X

G3 TRAINING





# ARMY - AMC VISION

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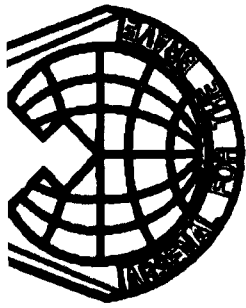
## ARMY

AMERICA'S ARMY, TRAINED & READY,  
A STRATEGIC FORCE, SERVING  
THE NATION, AT HOME AND ABROAD,  
CAPABLE OF DECISIVE VICTORY...INTO  
THE 21st CENTURY

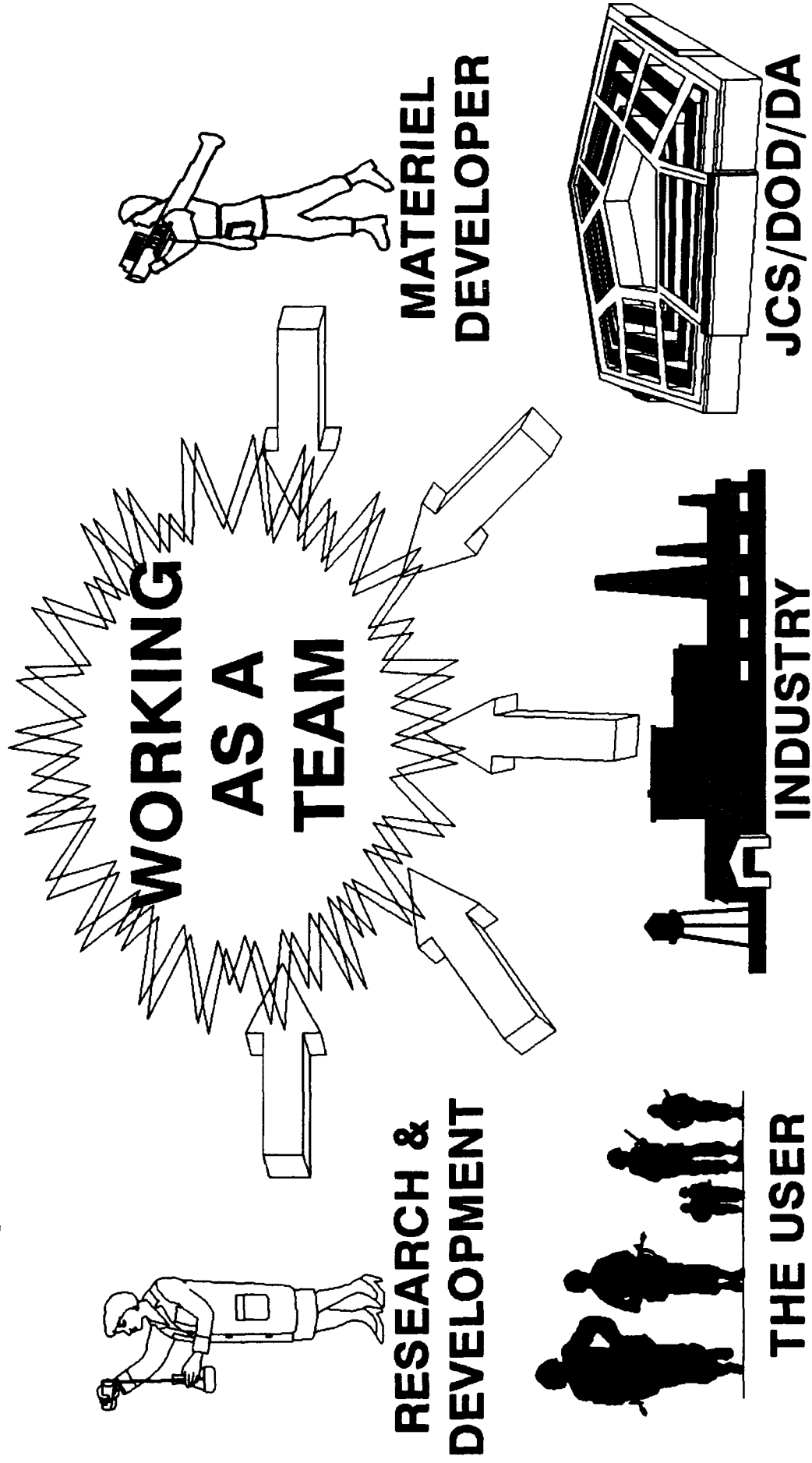
## AMC

THE LEADER IN EQUIPPING AND  
SUSTAINING AMERICA'S ARMY  
THROUGH SUPERIOR  
TECHNOLOGY AND RESPONSIVE  
SUPPORT ASSURING WORLD  
WIDE POWER PROJECTION AND  
DECISIVE VICTORY.

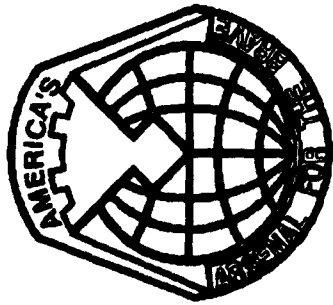
**"STRATEGIC FORCE...DECISIVE VICTORY"**



# ACHIEVING THE VISION







# AMC CONCERNS

**EXTERNAL  
INFLUENCES**

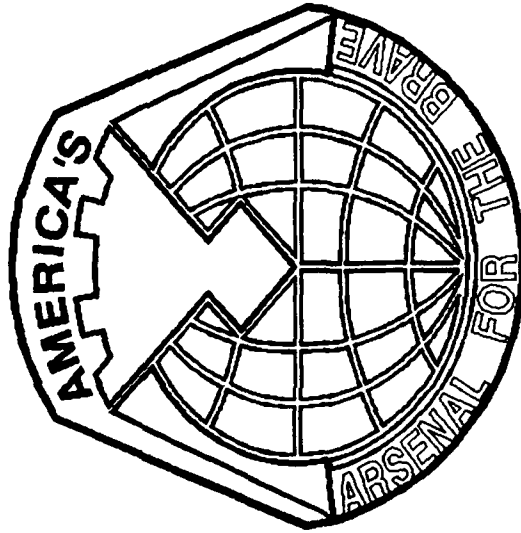
**FORCE XXI**

**LOUISIANA  
MANEUVERS**

**ACQUISITION  
REFORM**

**SHRINKING  
BUDGETS**

**BATTLE LABS**



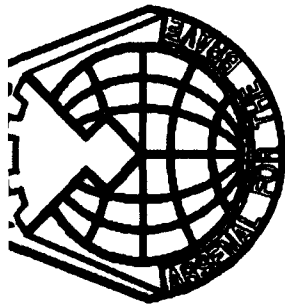
**INDUSTRIAL  
BASE**

**MAINTAIN  
SUPERIOR  
TECHNOLOGY**

**MODERNIZATION  
STRATEGY**

**ARMY WAR  
RESERVES**

**INVENTORY  
REDUCTION  
PROGRAM**



# READINESS OF AMERICA'S ARMY

## WITH THE UNITS

LOG ASST REPS: 825  
LOG ASST OFF: 41  
COUNTRIES: 9

PANAMA, HONDURAS, GERMANY,  
ITALY, MACEDONIA, KUWAIT,  
SWA, KOREA, US

## UNIT STATUS REPORTS

> 5,200 REPORTING UNITS  
= 24 MAJOR COMBAT UNITS  
DA 2715  
DA 2406 EQUIP SHORTAGES  
DA 1352 MAINT STATUS

## EQUIPMENT READINESS

ALL REPORTABLE ITEMS: JUNE 94  
419,000 (93% FMC)  
REPORTABLE LINE ITEMS:  
429 (306 MEET GOAL - 71%)  
REPORTABLE SYSTEMS:  
158 (91 FMC - 58%)  
MAJOR WEAPON SYSTEMS:  
16 (14 UP [PATRIOT, UH-60])

## TOTAL PACKAGE FIELDING SYSTEMS FIELDING AS OF

APR 94: 2598 EA  
LIKE: SINGGARS, RADIC INST,  
HMMMW

## MATERIAL MANAGEMENT: JUN 94

SUPPLY AVAILABILITY: 88.2% (GOAL 85%)  
NON MSN CAPABLE SPLY 9.2% (28K OF 307K  
AUTH STOCKAGE LIST % ZERO BAL  
12% (GOAL 8% - LAST 6 MO AVG = 12.4%)

## NEW EQUIPMENT TRAINING

888 CLASSES FY94  
25,414 TRAINED

## DEPOT MAINTENANCE

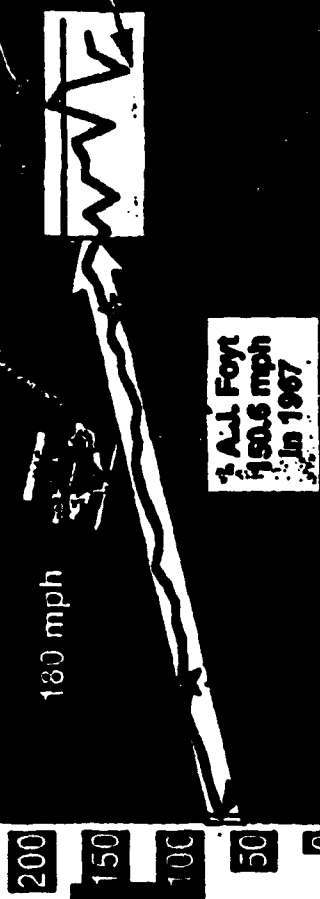
OVERHAUL: (M109 HOW. PATRIOT  
CHINOOK, BRADLEY)  
CONVERSIONS: (M113A2 TO M113A)  
REPAIR: (APACHE, BRADLEY, OH-58)  
REFURBISH: (BLACKHAWK)  
UPGRADE/MODERNIZE: (M1 TO M1A2)  
- \$716M FUNDED FY94  
- WORKLOAD OF \$1.28B

## LOGISTICS SUPPORT ACTIVITY

MAINTENANCE TROUBLE SHOOTING  
PS MAGAZINE 130,000 ISSUES/MO  
ARMY OIL ANALYSIS - 28 LABS  
91,660/MO (AVG; GRND + AIR)  
LOG INTEL FILES (LIE) (459K/MO AVG)  
PLI/ASL DEVELOPMENT  
MORE...

# Indy... Leveraging Technology To Break The "Barriers"

## Indianapolis 500 Winning Speed Averages



**A.J. Foyt**  
150.6 mph  
in 1967

1111122223333  
12488924892489  
Year

**Peter De Paolo**  
Breaks  
100 mph Barrier 1925

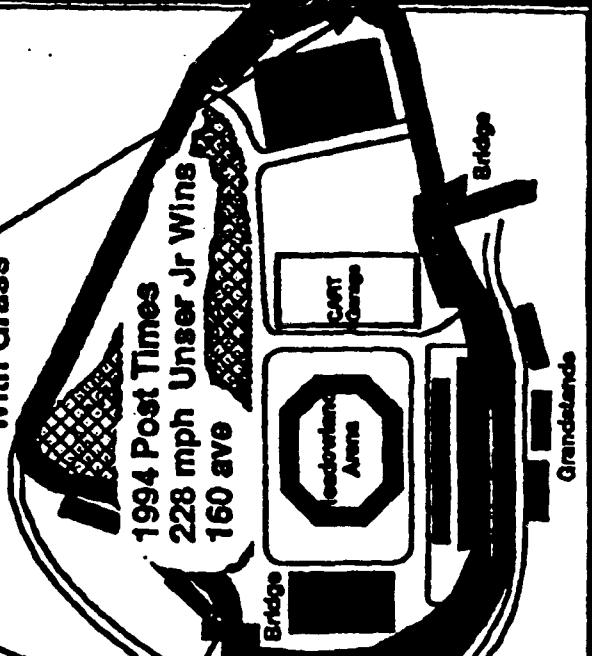
**Ray Harroun**  
Wins  
(6-42-06 -  
74.59 mph)

185.9 in 1990 - Arie Luyendyk  
Qualifying time was 223.3 mph

1992: Al Unser Jr. at 134.7 mph  
Guerrero Wins Pole Position With 232.48 mph  
12 Of 33 Cars finish  
10 Crashes Claimed 13 Cars; 13 Drivers Injured

**Slow Down**

1993: New Rules with 157.2 mph  
- Longer Chassis  
- Engine "Boost" restrictions  
- Carbon Fiber "Tubs" for Drivers  
- Apron On Curves Replaced With Grass



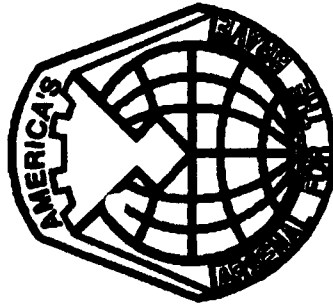
## How You Go Fast On A "Slower" Track

4 Tons Of Lateral G Force

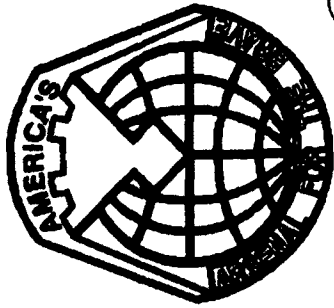
40 / 60 Weight Dist Composite "Tub"

Redesign Front & Rear Wings: 2 Tons Total Down Force

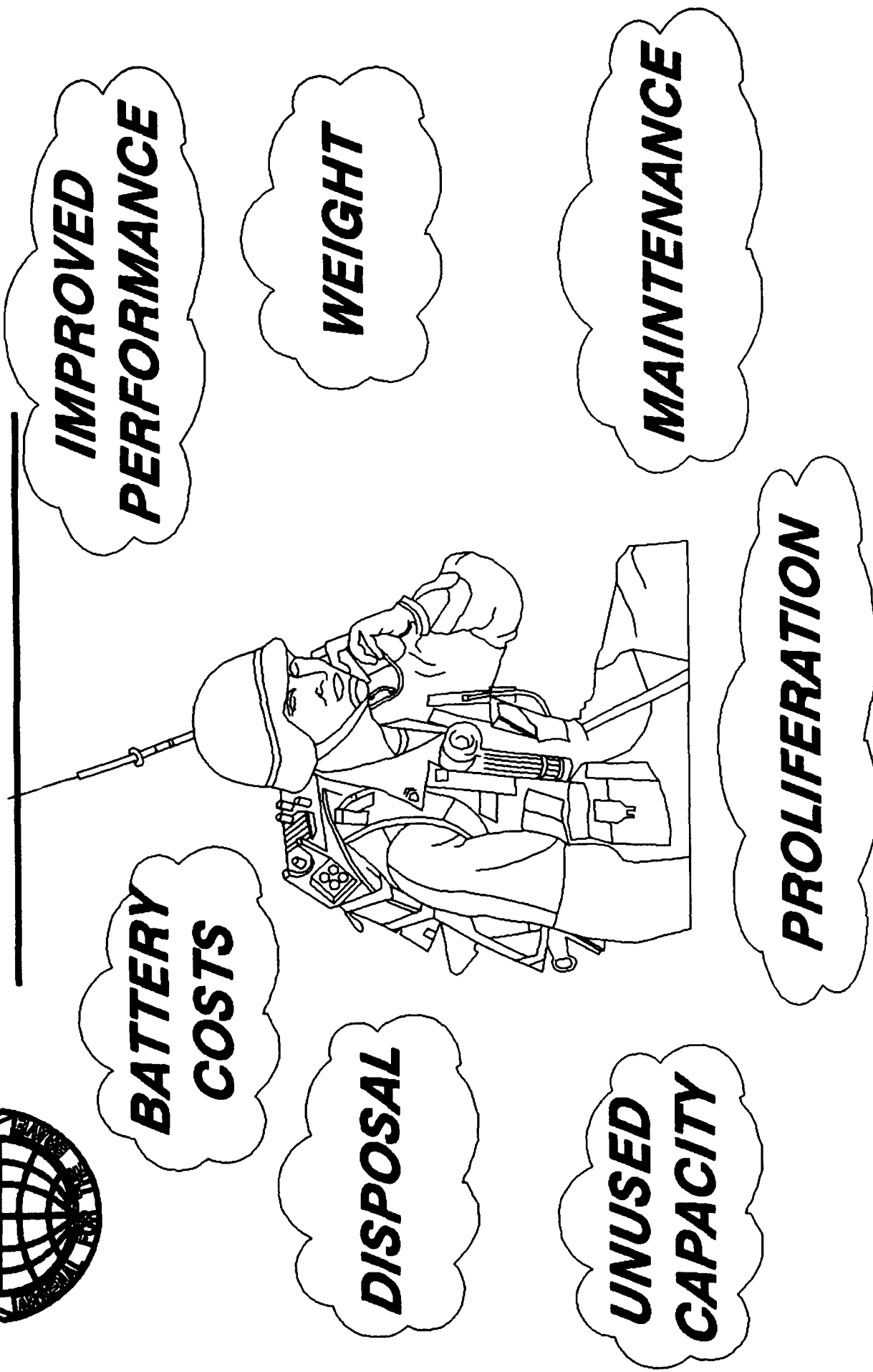
Smaller Engines Horsepower Air Intake Compression

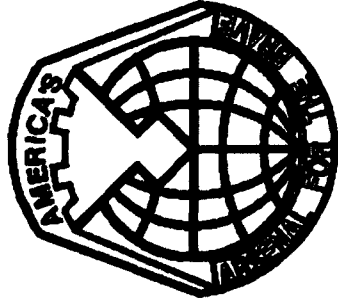


# POWER SOURCES



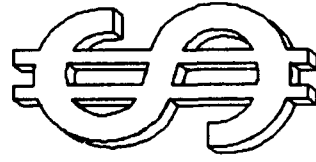
# FIELD CONCERNS



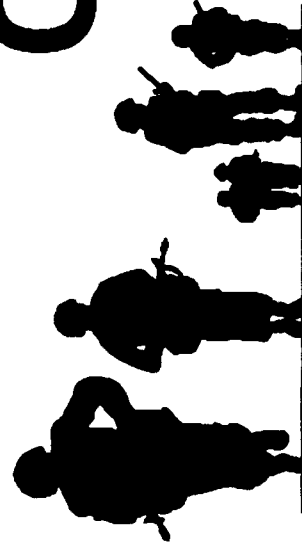


# **BATTERY RELATED OPERATION & SUPPORT COSTS**

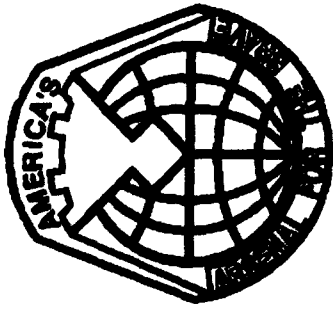
## **BATTERY RELATED**



## **COSTS ARE OF INCREASING CONCERN TO**



## **THE FIELD COMMANDERS**



# **AMC POWER SOURCES CHALLENGES**

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**REDUCE O&S COSTS**



**DEVELOP IMPROVED, COST**

**EFFECTIVE POWER SOURCES**

**INFLUENCE END ITEM DESIGN**



**REDUCE NUMBER OF UNIQUE BATTERIES  
DEVELOP/FIELD POWER SOURCES BASED**



**ON DUAL USE TECHNOLOGIES**



**PRESERVE/BUILD AN INDUSTRIAL BASE**



# ANSWERING THE CHALLENGE

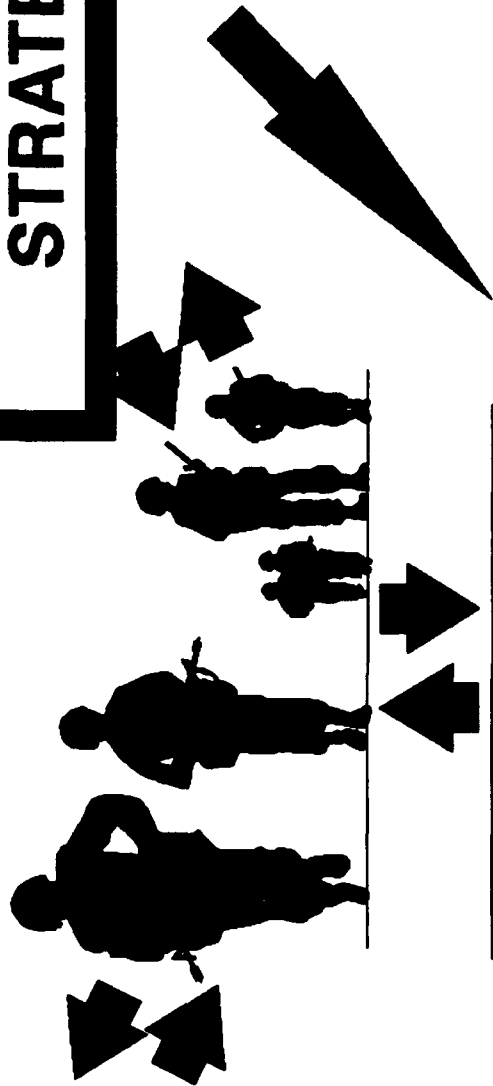
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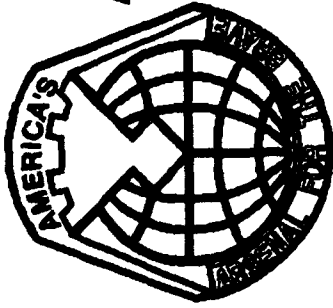
**AMC  
BATTERY  
FOCAL  
POINT**

**ARMY  
BATTERY  
MODERNIZATION  
STRATEGY**



**INDUSTRY**





# **ANSWERING THE CHALLENGE**

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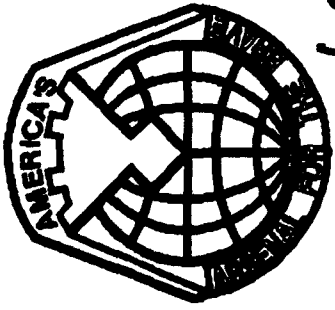
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## **ARMY BATTERY MODERNIZATION STRATEGY**

- \* PERFORMANCE
- \* SYSTEM DESIGN
- \* PROGRAM MGT
- \* CONTROL
- \* PROLIFERATION
- \* SAFETY

## **AMC BATTERY FOCAL POINT**

- \* IMPLEMENT STRATEGY
- \* COORDINATE AMC  
ACTIONS
- \* INTERFACE WITH USERS
- \* INTERFACE WITH INDUSTRY



# WHY ARE YOU HERE?

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✓ OPEN COMMUNICATIONS

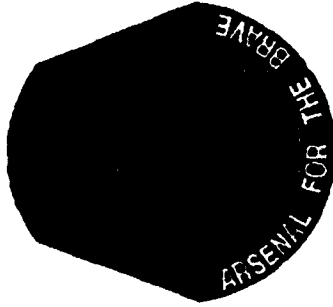
✓ LEARN WHERE WE ARE GOING

✓ MEET FUTURE CHALLENGES TOGETHER

✓ PROVIDE IDEAS/SUGGESTIONS

✓ BUSINESS OPPORTUNITIES





# SUMMARY

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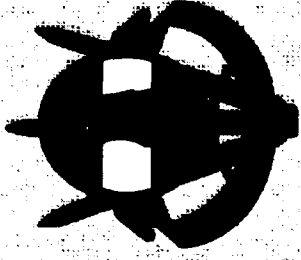
- ▶ **POWER SOURCES ARE OF SIGNIFICANT CONCERN TO THE ARMY**
- ▶ **AMC IS BEING PROACTIVE IN RESOLVING THESE CONCERNS**
- ▶ **INDUSTRY ASSISTANCE IS REQUIRED**

# NOTES

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**U.S. ARMY TRAINING AND  
DOCTRINE COMMAND  
(TRADOC)  
FUTURE  
NEEDS/REQUIREMENTS**

**THE UNITED STATES ARMY  
COMBINED ARMS SUPPORT COMMAND**



**BATTERY REQUIREMENTS/MODERNIZATION STRATEGY**

**FT LEE VA  
23801-6000**

**CW2 KEN SANBORN  
(804)734-0583**

**UNCLASSIFIED**



# The Land Warrior System

## Communication and Computer System

- Computer
- Intrasquad Radio
- Intersquad Radio
- GPS (SAASM)
- Handheld Flat Panel Display
- Video Camera
- Video Capture Software
- Compatible With Combat ID Component
- \* GFE Software

## Protective Clothing and Individual Equipment

- Advanced Load Carrying Capability
- Improved Body Armor
- Laser Detector
- Improved Combat Uniform
- \*\* M45 Protective Mask
- \*\* Chem/Bio Garment/Glove/Boot
- \* Ballistic/Laser Eye Protection
- \* Other Existing CIE
- † Combat ID Receiver (PM-CID)

## Integrated Headgear

- Lightweight Helmet With Suspension System
- Head/Helmet-Mounted Display Image Intensifier (I<sup>2</sup>) With Integrated Flat Panel Display

## Weapon System

- Laser Rangefinder
- Digital Compass
- Wiring Harness
- \*\* Modular Weapon System
- \*\* Thermal Weapon Sight (TWS)
- \*\* Close Combat Optic
- \* AN-PAQ4B - IR Laser Aiming Light
- \* Other Existing Weapons & Accessories



BLACK = LW Development and Integrated Into LW by Contractor  
 RED\*\* = GFE to K (Still Being Developed); Integrated Into LW System  
 ORANGE\* = GFE to K (Already Type Classified); Integrated Into LW System  
 GREEN† = Separate Program Interface With LW

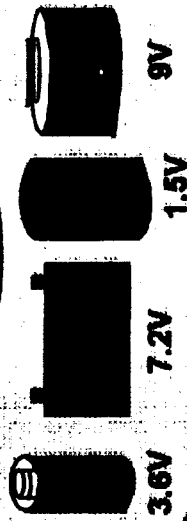
# THE BATTERY CHALLENGES

MANAGEMENT



System design is done. Now we need a new battery

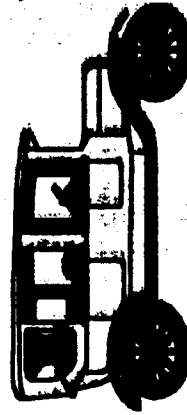
STANDARDIZATION



\$\$\$

\$14.3 M spent for 6TL batteries annually

OUTDATED TECHNOLOGY



Vented lead-acid automotive batteries are older technology

HIGH USAGE

IN EXCESS OF 250,000 USED ANNUALLY BY TACOM





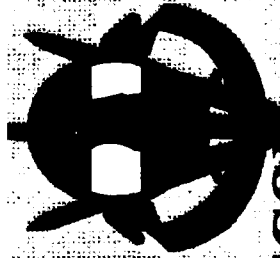
**CG TRADOC**



**"Fix the Battery Problem"**



**CG CASCOM**



**Identified and Assessed  
Field Cdr's Concerns  
Established an**

**ARMY**

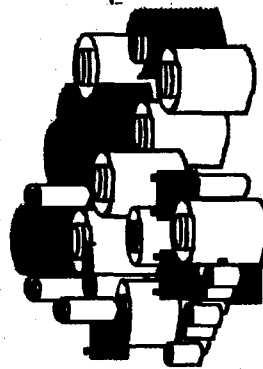
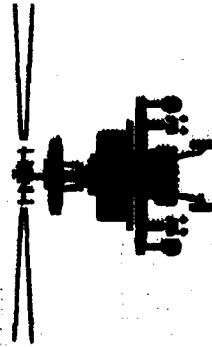
**BATTERY**

**CONFEDERATION**

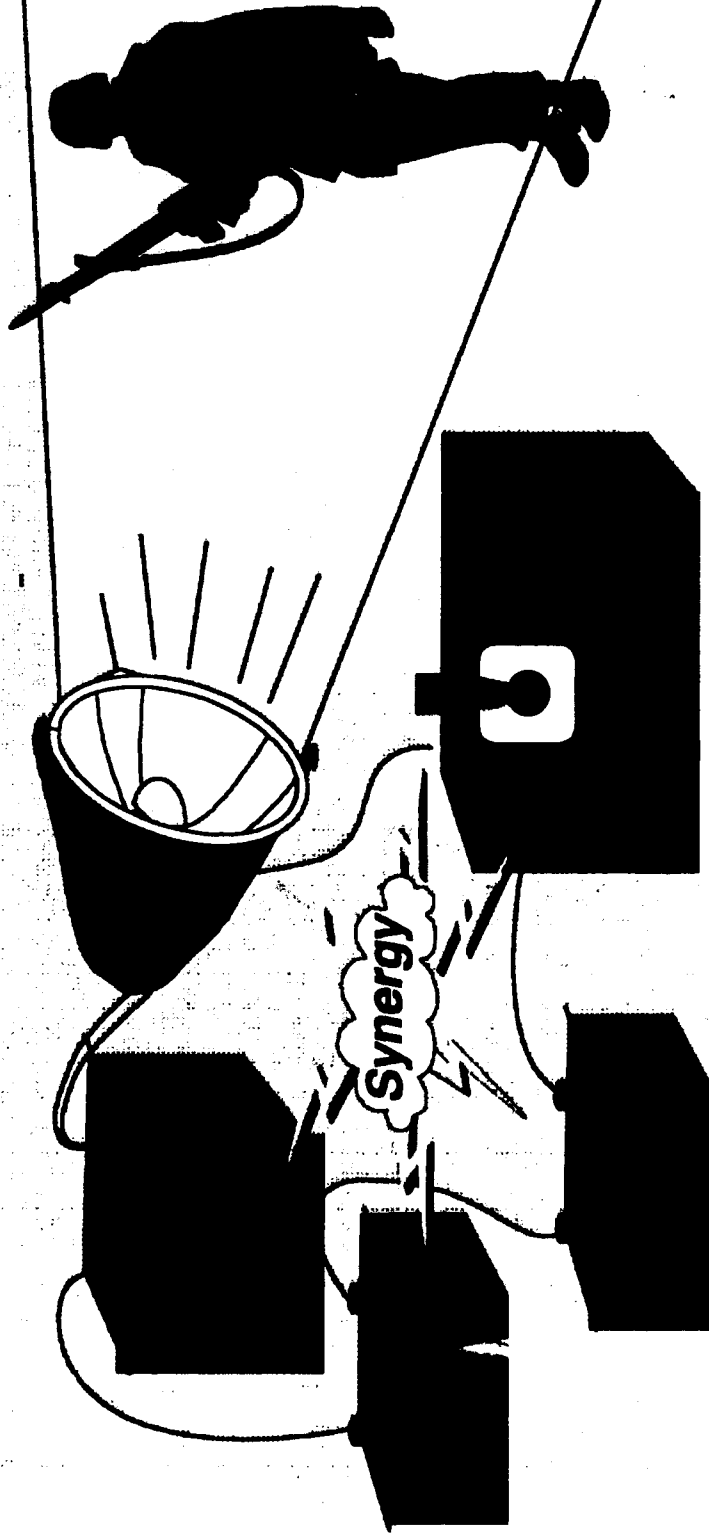
- AMC(CECOM)
- TRADOC(CASCOM)
- FORSCOM

**Prepared a Battery**

**Modernization  
Strategy**



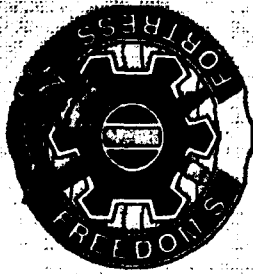
## Key Players



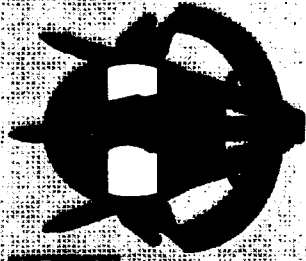
Providers

Users

...sum of the parts is greater than the whole...

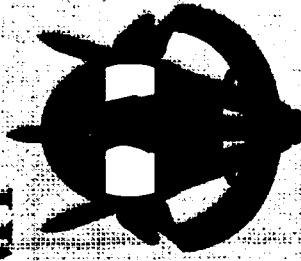


## **Army Battery Center of Excellence**

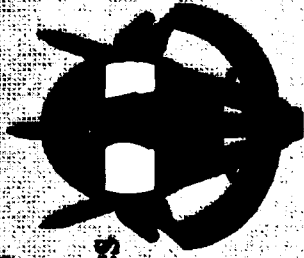
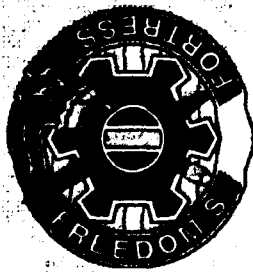


- Formed as a part of the Army Battery Modernization Strategy
- Short term goals established.
- Major short term goal: Establishment of a Program Manager for batteries.
- Members
  - TRADOC(CASCOM)
  - AMC(CECOM)
  - Forces Command

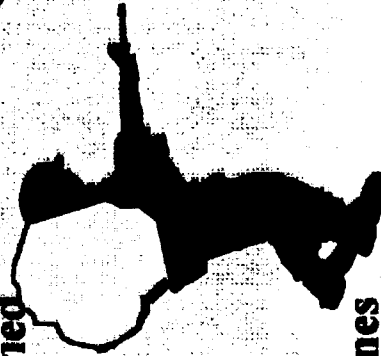
# BATTERY NEEDS OF THE ARMY



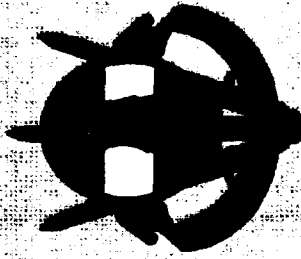
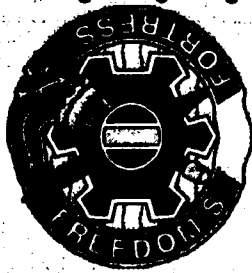
## OVERALL BATTERY CONCERNS



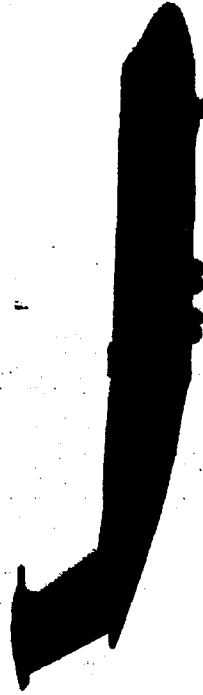
- Limited number of uses of primary batteries
- Old battery technology
- Spare batteries must be carried
- Hazardous waste disposal
  - Handling
  - Transportation
  - Costs
- EPA fines
- Constantly changing guidelines
- 3 demands in 90 days to be kept on hand
- Resupply of unique batteries difficult



# OVERALL BATTERY CONCERNS



- Too many different types
- Special handling for deployments
- Contingency and wartime surge  
e.g. Chemical Alarm Batteries
- Retrograde Operations  
Desert Shield/Storm  
Operation Restore Hope
- Health Hazards/Fatalities  
Short Term  
Long Term
- State of charge indicators very limited





## **WATERCRAFT BATTERY NEEDS**

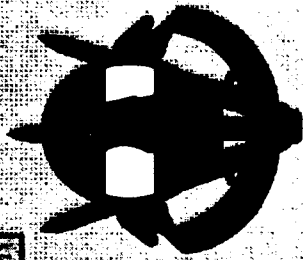
- **Technology demonstration at Ft Eustis using nickel-cadmium batteries.**
- **Currently using lead acid batteries.**
  - **6 volt and 12 volt**
  - **Changed twice a year.**
- **Need one standard battery for watercraft**
  - **Hot and cold climate capability**
  - **Low rate of self discharge**
  - **Low or No maintenance requirements.**



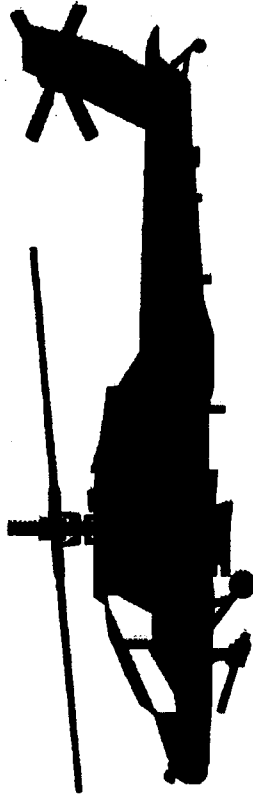
- Increased power and mission requirements have made the current 6TL lead-acid batteries ineffective.
- Mounted Battle Lab Under Armor APU designed to meet requirements. Two 6TL batteries cannot start the tank without APU assistance.
- Newer technology battery needed just for the APU and the M1 tank.
- Study done in 1993 shows batteries number one item needing constant attention on the M1 tank.



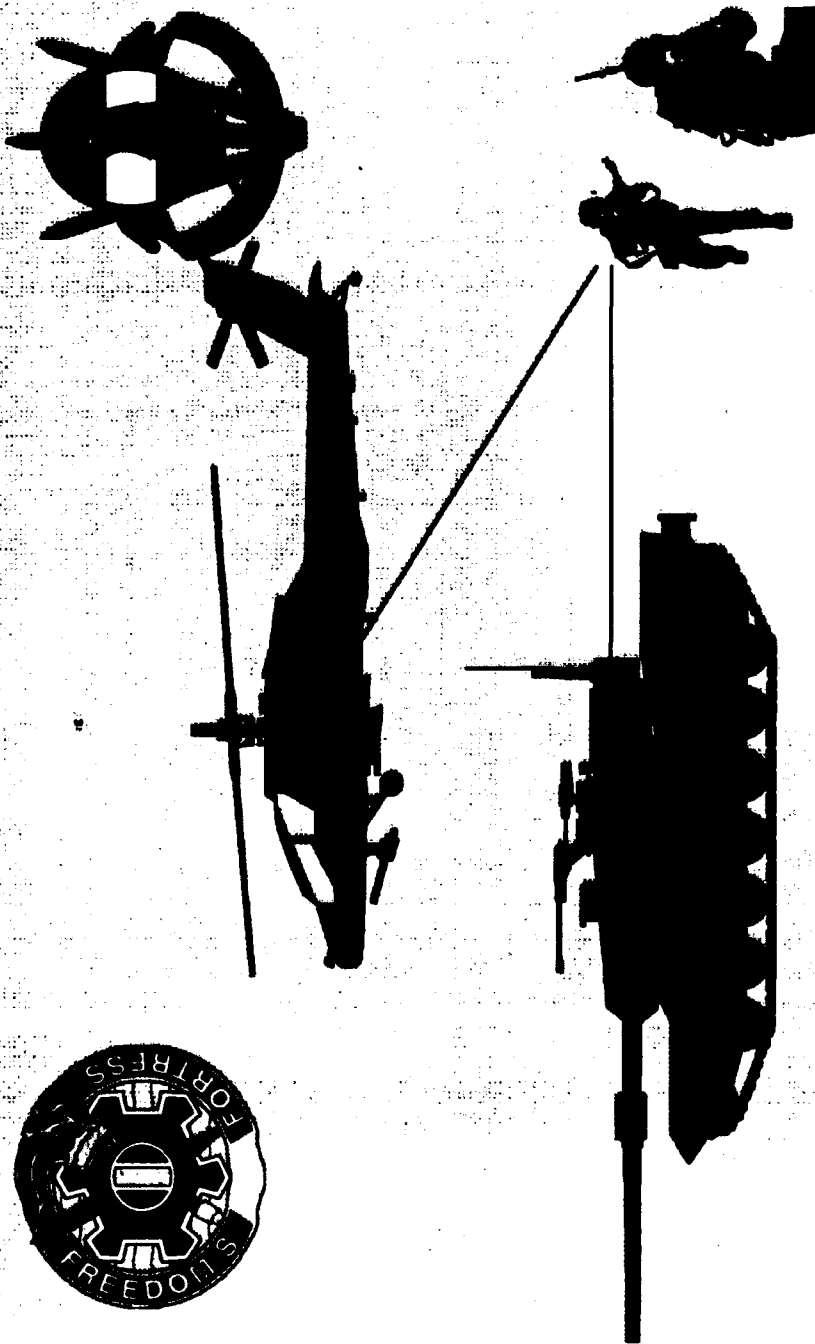
## AVIATION BATTERY NEEDS



- Army aviation is using vented nickel-cadmium batteries.
- High failure rate results in:
  - Excessive down time
  - Effects mission readiness
- Newer technology battery needed to reduce maintenance and increase readiness.
- A standard battery for aviation is needed.

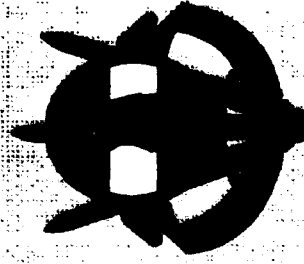


# COMMUNICATIONS AND ELECTRONICS



**For now need batteries that have high power, longer shelf lives, increased number of uses(Primary) and cycles lives (Secondary) to do the mission..**

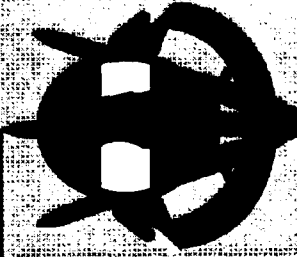
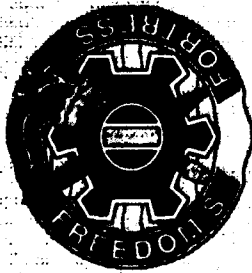
## **ARMY EFFORTS**



### **Combat Developers emphasis of:**

- **Multiple adapter configuration to use different primary and rechargeable batteries.**
- **Insertion of new technology.**
- **Reduction of military standards in equipment.**
- **Dual use technology.**
- **Power reduction circuitry.**
- **Power management circuitry.**
- **Direct Vendor Delivery.**
- **Investigation of technology from agencies such as NASA and DOE laboratories.**

# NAV SYSTEMS PRODUCTS CORPORATION



- **Requirements Documents**
  - **Use Commercial Off the Shelf**
  - **Army Preferred**
  - **Power Mgt Techniques**
  - **Power Reduction Circuitry**
  - **State of Charge Indicator**
- **Training**
  - **Safety**
  - **Battery Maintenance**
  - **Hazardous Waste**
- **Command Emphasis**
  - **Training**
  - **Lowest Level**

## **INDUSTRY FUTURE**

### **Industrial Development of:**

- **Lighter, high energy, increased cycle life for primary and rechargeable batteries.**
- **Multi-chemistry/fast/smart battery chargers.**
- **Environmentally friendly chemistries.**
- **Surge requirements.**
- **Reduce battery purchase cost.**
- **Recycling facilities for newer chemistries**
- **Batteries and/or cells that can be used in multiple configurations.**

# NOTES

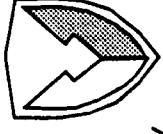
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# **ARMY RESEARCH LABORATORY (ARL)**

## **POWER REQUIREMENTS**



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MATERIEL COMMAND

# *PORTABLE POWER SOURCES*

DR R.P. HAMLEN  
Director, Power Sources Division  
Electronics and Power Sources Directorate

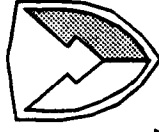
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RESEARCH LABORATORY

## ***BATTERY RELATED FUNCTIONS***

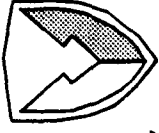


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MATERIEL COMMAND

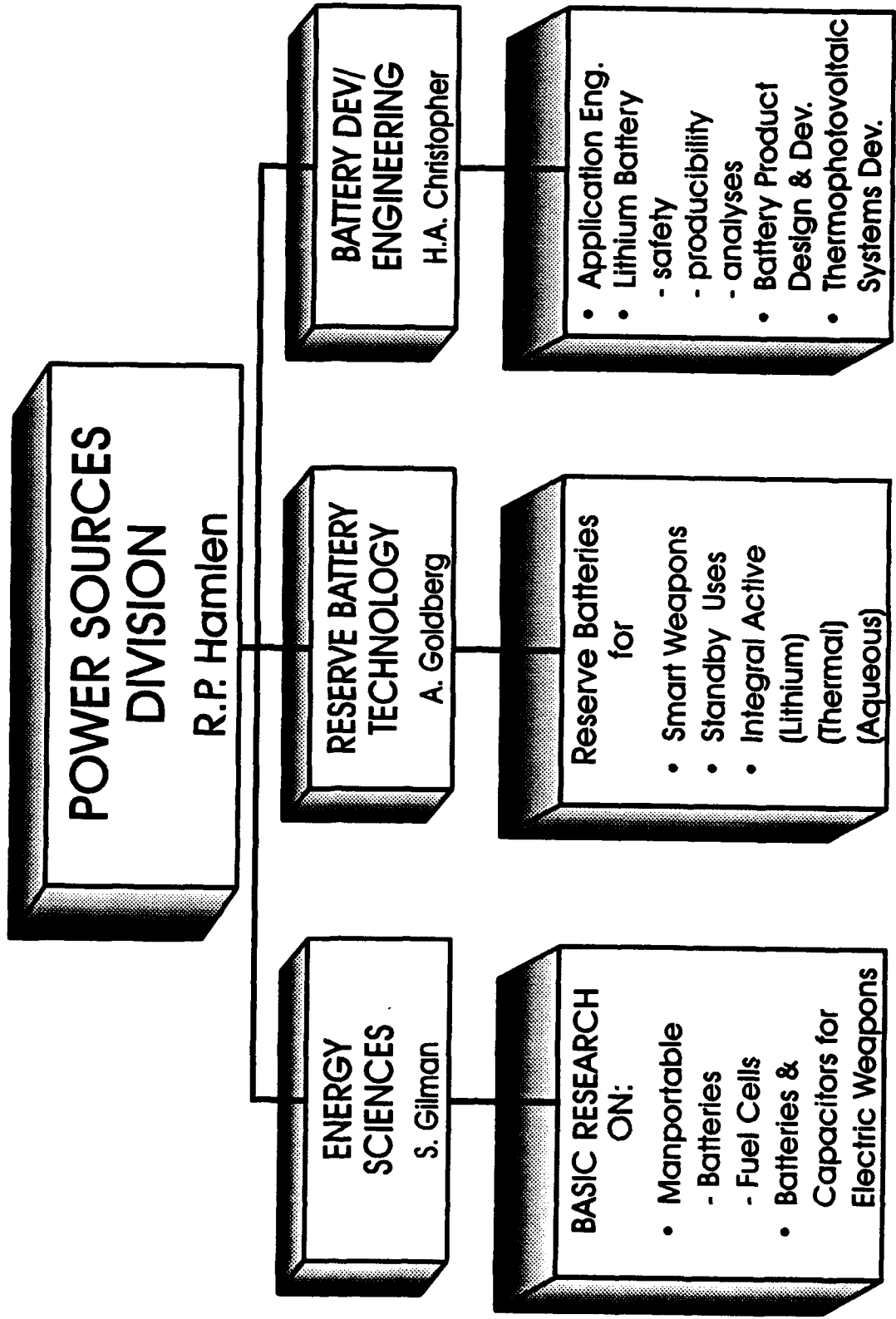
- CONDUCT R&D ON FUTURE BATTERIES
- DEVELOP IN CONJUNCTION WITH CONTRACTORS
- APPROVE NEW TYPES FOR USE
- QC TESTING ON LITHIUM BATTERIES



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# POWER SOURCES PROGRAMS



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## THROWAWAY BATTERIES

- NEXT GENERATION PRIMARY
- SOLDIER SYSTEM PRIMARY

## RECHARGEABLE BATTERIES

- IMPROVED ENERGY DENSITY
- LOW COST

## RESERVE BATTERIES

- LI-BASED SYSTEMS
- LONGER MISSION LIFE

## PULSE BATTERIES AND CAPACITORS

- ELECTRIC GUN
- ELECTRIC DRIVE VEHICLE

## FUEL CELLS

- SOLDIER SYSTEMS
- TANK SILENT WATCH
- FIELD POWER GENERATION

## ALTERNATIVE POWER SOURCES

- THERMOPHOTOVOLTAIC ENERGY  
GENERATION



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## ***POWER SOURCES DIVISION***



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### **KEY BATTERY CONCERNS**

#### **I. PERFORMANCE**

- ENERGY, POWER, WEIGHT, TEMPERATURE
- SAFETY-TRANSPORTATION, USE, DISPOSAL
- SMART CHARGER, STATE-OF-CHARGE

#### **II. COST**

- PEACETIME TRAINING

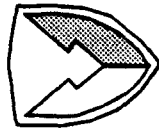
#### **III. PROLIFERATION OF BATTERY TYPES**

- PRIOR TO LITHIUM-LITTLE CONTROL
- NOW - STANDARD FAMILY



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# POWER SOURCES DIVISION



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## KEY BATTERY CONCERNS

(Continued)

### IV. DIVERSIFIED APPLICATIONS

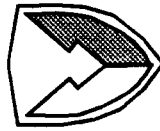
- COMMUNICATIONS-ELECTRONICS
- TANK STARTING AND SILENT WATCH
- PULSE POWER
- AIRCRAFT STARTING

### V. INDUSTRIAL BASE



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# FAMILY OF STANDARD BATTERIES



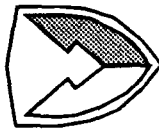
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<div>CAPACITY CURRENT VOLTAGE</div>	NON RECHARGEABLE LOW POWER Li/SO <sub>2</sub>	RECHARGEABLE LOW POWER Ni-Cd	NON RECHARGEABLE HIGH POWER Li/SO <sub>2</sub>	RECHARGEABLE HIGH POWER Ni-Cd
3	BA-5567/U			
6	BA-5372/U		BA-5847/U	BB-X847/U
12	BA-5588/U	BB-588/U		
24			BA-5590/U	BB-590/U

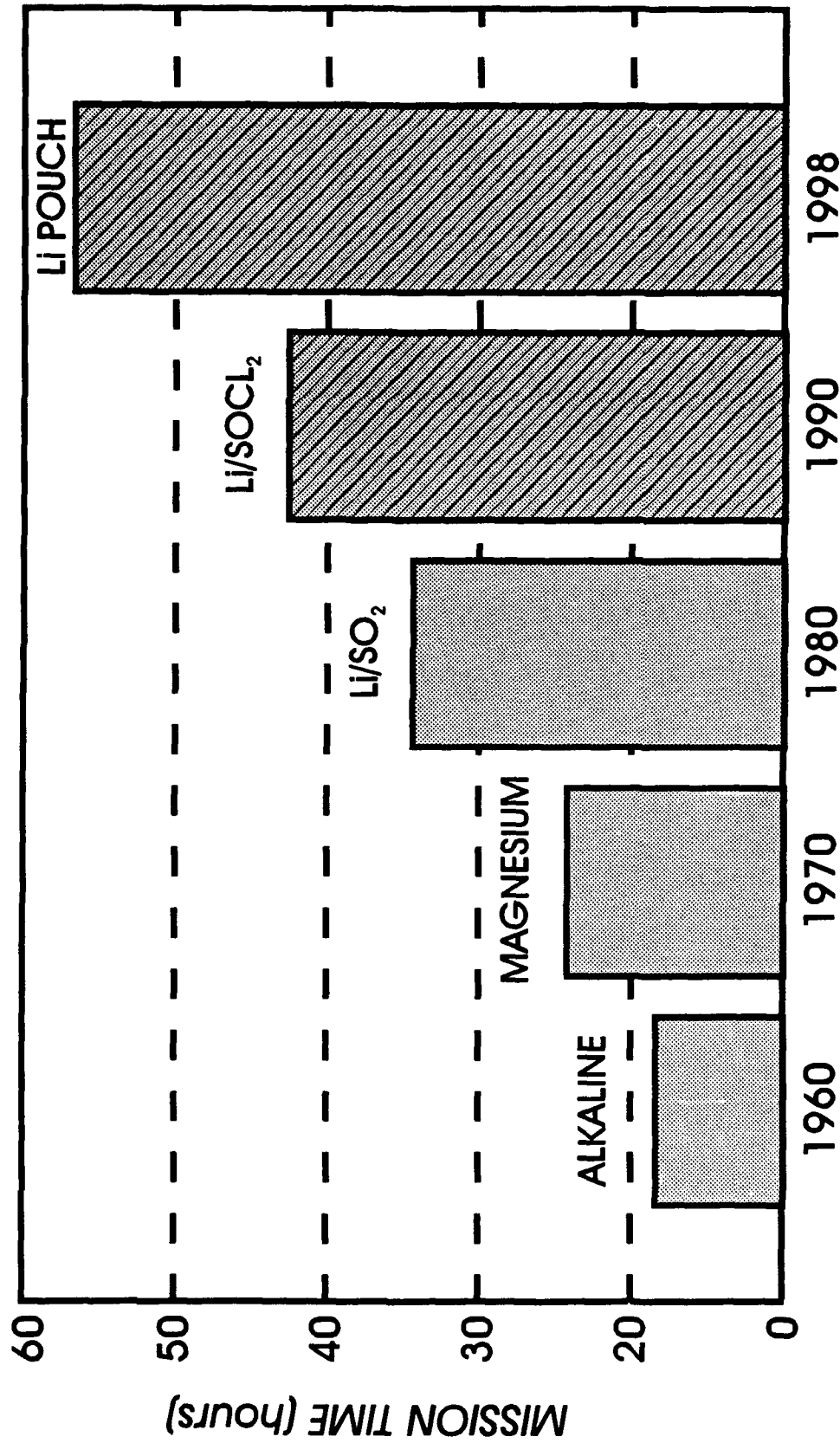


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# ADVANCES IN PRIMARY BATTERIES FOR HIGH POWER DENSITY APPLICATIONS\*



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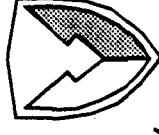


\* SPECIFIC DATA FOR THE BA-5590/U IN THE SINGARS RADIO



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# LITHIUM-MANGANESE DIOXIDE PRIMARY BATTERIES



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---

## CYLINDRICAL CELLS

- SMALL CELLS- AVAILABLE: CAMERAS, SMOKE ALARMS
- D CELLS - AVAILABLE: SEARCH AND RESCUE BEACONS (8 Ahrs.)

## POUCH CELLS

- MAXIMIZE USE OF AVAILABLE BATTERY VOLUME
- MORE ENERGY PER UNIT OF VOLUME
- EASIER/CHEAPER TO MANUFACTURE THAN SPIRAL WOUND CELLS
- FOIL CONSTRUCTION - NO SHRAPNEL
- POUCH CELL FOR BA-XX90/U 14 Ahrs.

## TECHNICAL CONCERNS

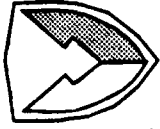
SAFETY, LOW TEMP OPERATION, SHELF LIFE





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## POWER SOURCES DIVISION



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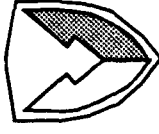
# RECHARGEABLE BATTERIES

- TRAINING
- SOF
- TANK STARTING/SILENT WATCH
- AIRCRAFT STARTING



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# POWER SOURCES DIVISION



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## SINCGARS ALTERNATIVES AVAILABLE TODAY

BA-5590/U BB-590/U BB-490/U  
LITHIUM S02 (P)\* NICKEL-CADMIUM (R)\*\* LEAD-ACID (R)

BATT/MISSION (8 hrs)	1	2	2
MISSIONS/BATT	3.1	0.79	0.55
WT/MISSION	2.2 LBS	7 LBS	6.8 LBS.
COST/YR	\$4,393	\$496	\$2675
DISPOSAL/YR	\$238	\$3	\$0

\* (P) PRIMARY

\*\* (R) RECHARGEABLE



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# COMPARISON OF EXISTING AND FUTURE RECHARGEABLE BATTERIES

BB590/U SIZE, 2.45"x5"x4.4"-24V.



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<u>PRODUCTS AVAILABLE</u>	<u>Wh/Kg</u>	<u>AH</u>	<u>SAFETY</u>	<u>CYCLES</u>	<u>COMMENTS/LIMITATION</u>
Ni Metal Hydride	42	3.4	+	200+	Potential For Improvement
NiCd	30	2.0	+	250+	Heavy/Low Mission Life
Lead-Acid	25	1.6	+	100	Heavy/Lower Mission Life



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# COMPARISON OF EXISTING AND FUTURE RECHARGEABLE BATTERIES

BB590/U SIZE, 2.45"X5"X4.4"-24V.



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Continued

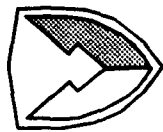
<u>FUTURE CANDIDATES</u>	<u>Wh/Kg</u>	<u>AH</u>	<u>SAFETY</u>	<u>CYCLES</u>	<u>COMMENTS/LIMITATION</u>
Li-ion	88	4.5	?	200+	Safety in Large Sizes
Metallic Li	110	5.0	?	50	Safety/Risk
Metallic Li/Polymer	150	7.0	?	50	Safety/Risk TBD
Rech. Alkaline	60	4.5*	+	10-30	Power/Temp. Limited

\* Low Rates Only

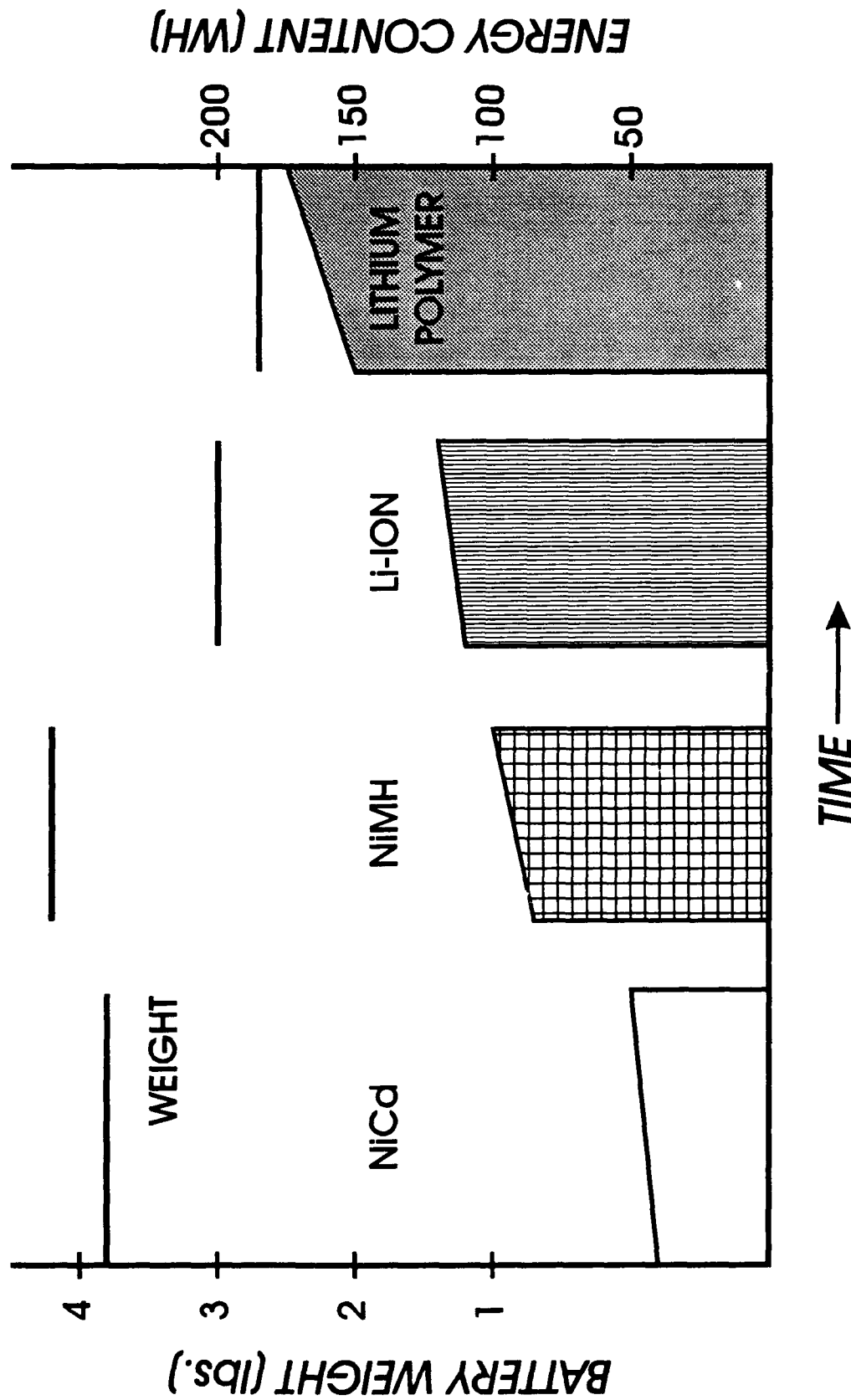


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# RECHARGEABLE BB590/U TYPE BATTERY FOR SOF C-E APPLICATIONS



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# ELECTROCHEMICAL RESEARCH

GOAL	IMPACT/APPLICATIONS
RECHARGEABLE LITHIUM BATTERIES	<ul style="list-style-type: none"> <li>- 1/10 cost of throwaway battery</li> <li>- Over 2 1/2x energy density of secondary battery</li> <li>- Reduced logistics if primary charging source available</li> </ul>
ELECTROCHEM CAPACITORS	<ul style="list-style-type: none"> <li>- Hybrid or electric vehicles: acceleration, dynamic braking</li> <li>- Conventional vehicles: engine starting</li> </ul>
PULSE POWER BATTERIES	<ul style="list-style-type: none"> <li>- Electric guns</li> <li>- Hybrid or electric vehicles</li> </ul>
FUEL CELLS	<ul style="list-style-type: none"> <li>- Manpack power source for long-duration microclimate cooling</li> <li>- Power Source for special operations</li> <li>- Stealth vehicles</li> </ul>



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# RECHARGEABLE LITHIUM BATTERIES



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## BASELINE TECHNOLOGY

- Ni/Cd (ENERGY DENSITY = 40 Whr/kg)
- Ni/METAL HYDRIDE (ENERGY DENSITY = 60 Whr/kg)

## GOAL

- MATERIALS AND BASIC TECHNOLOGY FOR:
  - ENERGY DENSITY > 100 Whr/kg, ALL-TEMP OPERATION
  - DUAL USE, HIGHEST USER SAFETY

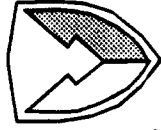
## APPROACH

- IMPROVED LIQUID ELECTROLYTES FOR "Li-Ion"  
(I.E.  $\text{LiC}_6$  ANODES) BATTERIES
- IONICALLY CONDUCTING POLYMER ELECTROLYTES  
FOR SOLID-STATE BATTERIES



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# RECHARGEABLE LITHIUM BATTERIES



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## ACCOMPLISHMENTS

- HIGH CONDUCTIVITY LIQUID ELECTROLYTES AVAILABLE FOR "Li-Ion" BATTERIES
- NEW POLYMER ELECTROLYTES FORMULATED

## FUTURE WORK

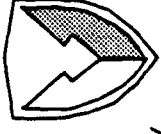
- LIQUID ELECTROLYTES: STABILITY WITH  $\text{Li}_x\text{C}_6$
- POLYMER ELECTROLYTES: FORMULATION/ DEMONSTRATION OF PROTOTYPE CELLS
- EXPLORATION OF CARBON FIBER CATHODES





US ARMY  
RESEARCH LABORATORY

## POWER MANAGEMENT



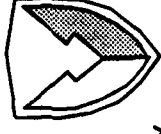
ARMY  
MATERIEL COMMAND

- **SIGNIFICANT POWER/ENERGY SAVINGS CAN BE ACHIEVED IN ELECTRONIC EQUIPMENT BY:**
  - Applying emerging device and architectural technologies
    - Low voltage analog/digital microelectronics
    - Reconfigurable parallel and pipelined architectures
  - Employing judicious engineering principles throughout the requirements/design/development process
    - Automatic shutdown, adaptive "sleep" modes, etc.



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RESEARCH LABORATORY

## POWER MANAGEMENT



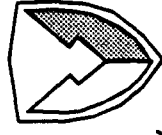
ARMY  
MATERIEL COMMAND

- CUMULATIVE EFFECT: POWER SAVING RANGING FROM 10% TO 90%  
DEPENDING UPON:
  - Willingness to incur moderate increases in NRE and production costs
  - System-Specific Performance and Operational Use
- ACQUISITION COST INCREASES CAN BE EASILY RECOVERED BY SAVINGS IN BATTERY COSTS WITHIN 1 TO 3 YEARS



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## POWER SOURCES DIVISION



ARMY  
MATERIEL COMMAND

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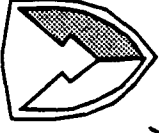
### KEY OBJECTIVES FOR FUTURE

- IMPROVED PRIMARY BATTERIES FOR SOLDIER SYSTEMS, NEXT GENERATION C4I THROWAWAY, LASER, RADAR AND NV SYSTEMS
- IMPROVED NEAR-TERM (NiMH) AND LONG-TERM (Li-ION) RECHARGEABLE BATTERIES (C4I, SOLDIER SYSTEM, TANK)
- RESERVE/ACTIVE BATTERIES FOR LONGER-LIVED, SMART MUNITIONS



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## POWER SOURCES *DIVISION*



ARMY  
MATERIEL COMMAND

### KEY OBJECTIVES FOR FUTURE

Continued

- HIGH RATE BATTERIES AND CAPACITORS FOR ELECTRIC WEAPONS AND VEHICLES
- FUEL CELLS FOR LONG-LIFE PORTABLE USE, TANK SILENT WATCH
- PORTABLE THERMOPHOTOVOLTAIC POWER GENERATORS



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## **BUSINESS OPPORTUNITIES**



ARMY  
MATERIEL COMMAND

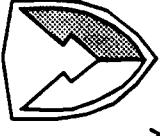
### **SMALL BUSINESS INNOVATIVE RESEARCH (SBIR)**

- PHASE I AND PHASE II
- SOLICITATIONS: SEP-OCT 94, MAY 95
- ESTIMATED AWARD DATES: 4 MONTHS AFTER SOLICITATION
- POSSIBLE TOPICS
  - Li / MnO<sub>2</sub> Cylindrical Cell Batteries
  - Li-ion / Polymer Electrolyte Rechargeable Batteries
  - Manportable PEM Fuel Cells
  - Electrochemical Capacitors
  - Thermophotovoltaic (TPV) Devices
  - Pulse Power Batteries



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## ***BUSINESS OPPORTUNITIES (Cont.)***



ARMY  
MATERIEL COMMAND

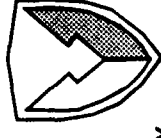
### **BROAD AGENCY ANNOUNCEMENT (BAA)**

- ARL
  - TOPICS: Compact, High Energy Density Reliable Batteries  
Reliable and Efficient Fuel Cells
- EPSD
  - TOPICS TBD Based On Customer Funding



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## ***BUSINESS OPPORTUNITIES (Cont.)***



ARMY  
MATERIEL COMMAND

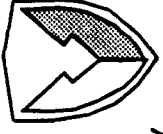
### **FOREIGN MATERIEL EXPLOITATION (D650)**

- ARL / EPSD PROPOSALS SUBMITTED FOR FY95
  - Primary Lithium Batteries
  - Rechargeable Batteries
  - Fuel Cells
- PROPOSAL ACCEPTANCE / REJECTION DUE SEP 94
- TOPICS TBD BASED ON ACCEPTED PROPOSALS
- FUNDING PROVIDED IN 1Q FY95
- ESTIMATED AWARD(S) DATE(S): 2Q FY95



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# **THERMOPHOTOVOLTAIC POWER GENERATION**



ARMY  
MATERIEL COMMAND

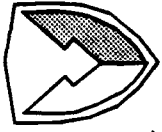
- NIGHT-TIME USE OF SOLAR PANELS
- MULTI-FUEL CAPABILITY
- SILENT OPERATION
- REMOTE BATTERY CHARGING





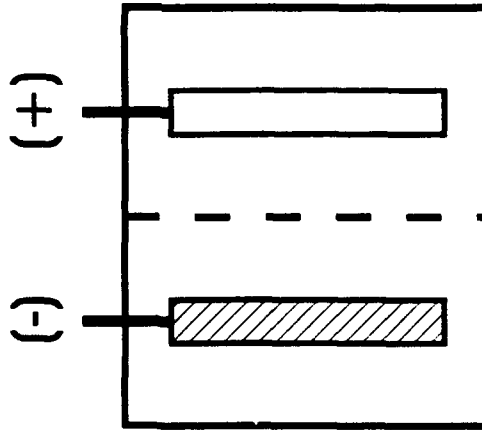
US ARMY  
RESEARCH LABORATORY

# BATTERIES vs FUEL CELLS

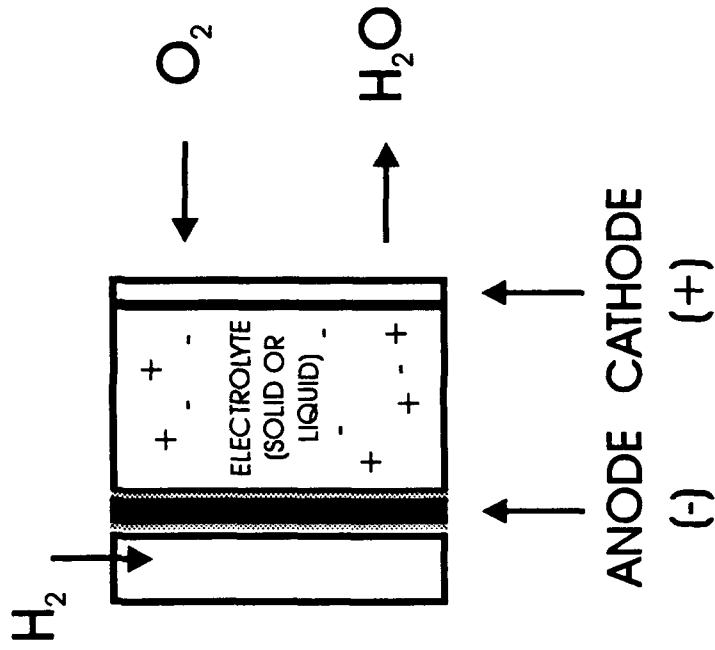


ARMY  
MATERIEL COMMAND

BATTERY  
SELF CONTAINED



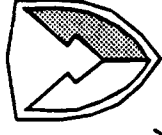
FUEL CELL  
CONTINUOUS FEED





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RESEARCH LABORATORY

# FUEL CELLS



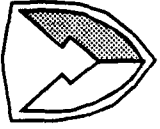
ARMY  
MATERIEL COMMAND

- BATTERY CHARGER
- LONG-DURATION C4I MISSIONS
- SOLDIER SYSTEMS
- TANK SILENT WATCH
- SILENT VEHICLES



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RESEARCH LABORATORY

# FUEL CELLS

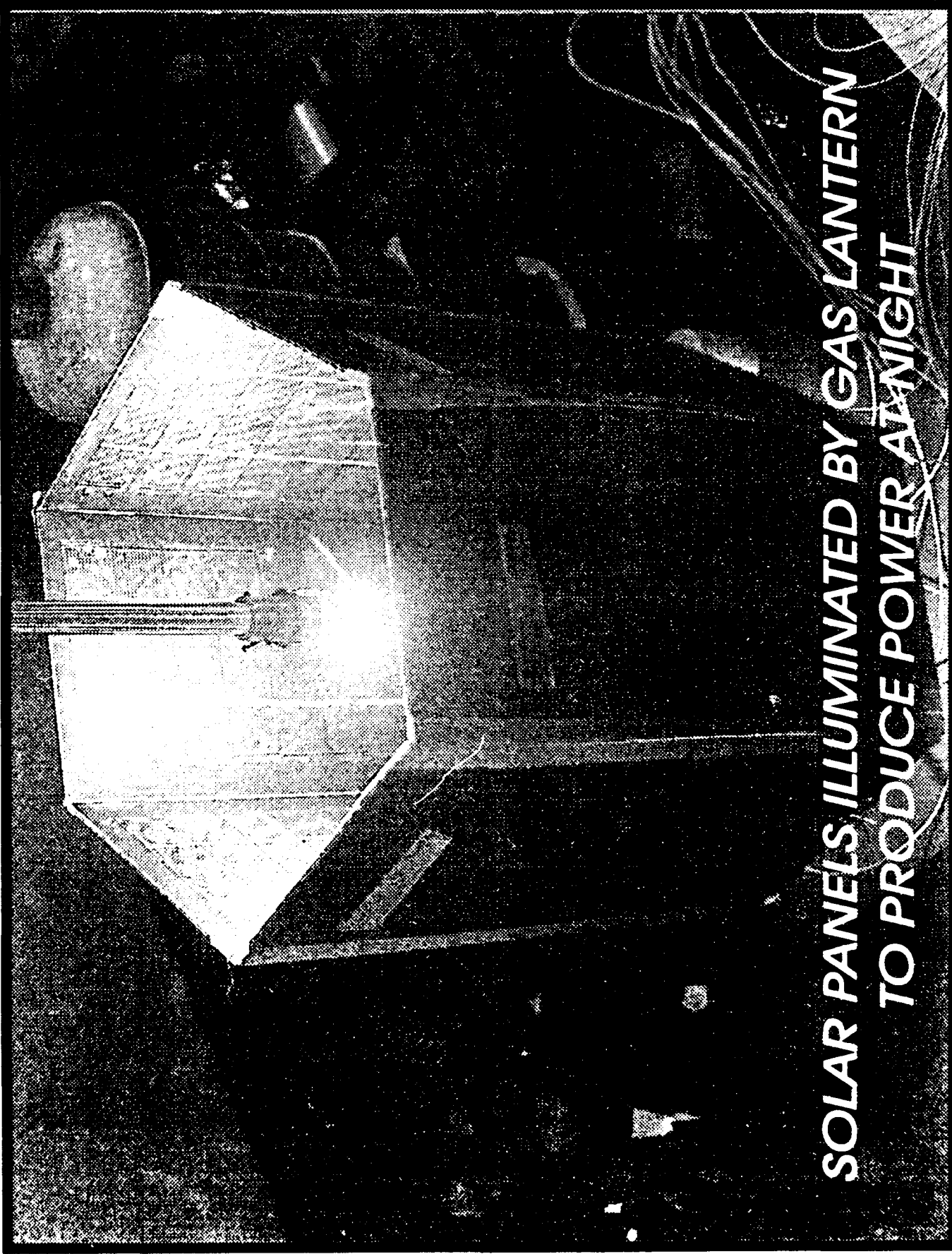


ARMY  
MATERIEL COMMAND

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## CURRENT PROGRAM

- IMPROVED MEMBRANES FOR POLYMER ELECTROLYTE MEMBRANE (PEM)
- IMPROVED ELECTROCATALYSTS FOR H<sub>2</sub> AND METHANOL FUEL CELLS
- HIGH POWER DENSITY H<sub>2</sub>/PEM FUEL CELL STACKS

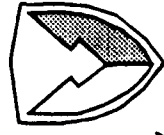


**SOLAR PANELS ILLUMINATED BY GAS LANTERN  
TO PRODUCE POWER AT NIGHT**

# NOTES



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ARMY  
MATRIEL COMMAND

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# POWER EFFICIENT ELECTRONICS

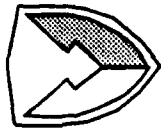
ROBERT HEUNER  
ARMY RESEARCH LABORATORY

UNCLASSIFIED



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RESEARCH LABORATORY

## LOW POWER/LOW VOLTAGE SYSTEMS AND CIRCUITS INDUSTRY STATUS



ARMY  
MATERIEL COMMAND

- Rapid Growth In Various Commercial Sectors

- Systems:

Notebook And Laptop PCs, Cellular Phones, Pagers, ...

- Components

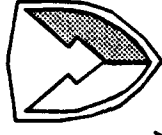
3 Volt Parts From Multiple Suppliers

- Gate Arrays, FPGAs, Standard Cell Families
- High Efficiency Regulators
- Portable PCs And Telecomm



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## LOW POWER/LOW VOLTAGE SYSTEMS AND CIRCUITS INDUSTRY STATUS



ARMY  
MATERIEL COMMAND

- Wide Spread Information Exchange
- 1st IEEE Low-Power Electronics Workshop - Jul 93
- IEEE-IEDM Short Course On Low Voltage/Low Power - Dec 93
- 1994 ISSCC Focuses On Low Power - Feb 94
- 1st IEEE Symposium On Low Power - Oct 94





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## BENEFITS OF REDUCED POWER



ARMY  
MATERIEL COMMAND

- Extend Battery Life, Other Chemistries
  - Increase Functionality Of Electronic Systems
  - Simplify Heat Sinking And Cooling Requirements
  - Reduce Cost, Size, Weight
  - Enhance Soldier Capability
- Power Reduction Goal  $\geq 30\%$



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## SEEKING INDUSTRY IDEAS AND SUPPORT



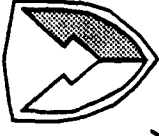
ARMY  
MATERIEL COMMAND

- Power Reduction Techniques
- Maximizing Commercial State-Of-The-Art Use
- Implementing In Portable Army Systems



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# CMOS POWER DISSIPATION



ARMY  
MATERIEL COMMAND

$$P = 1/2 CV_{dd}^2 F + V_{dd} I_L$$

Operating Power	Standby Power
--------------------	------------------

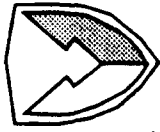
## Power Dissipation Reduction Factors

C = Load Capacitance  
V = Supply Voltage (Squared)  
F = Operating Frequency  
I = Leakage Current

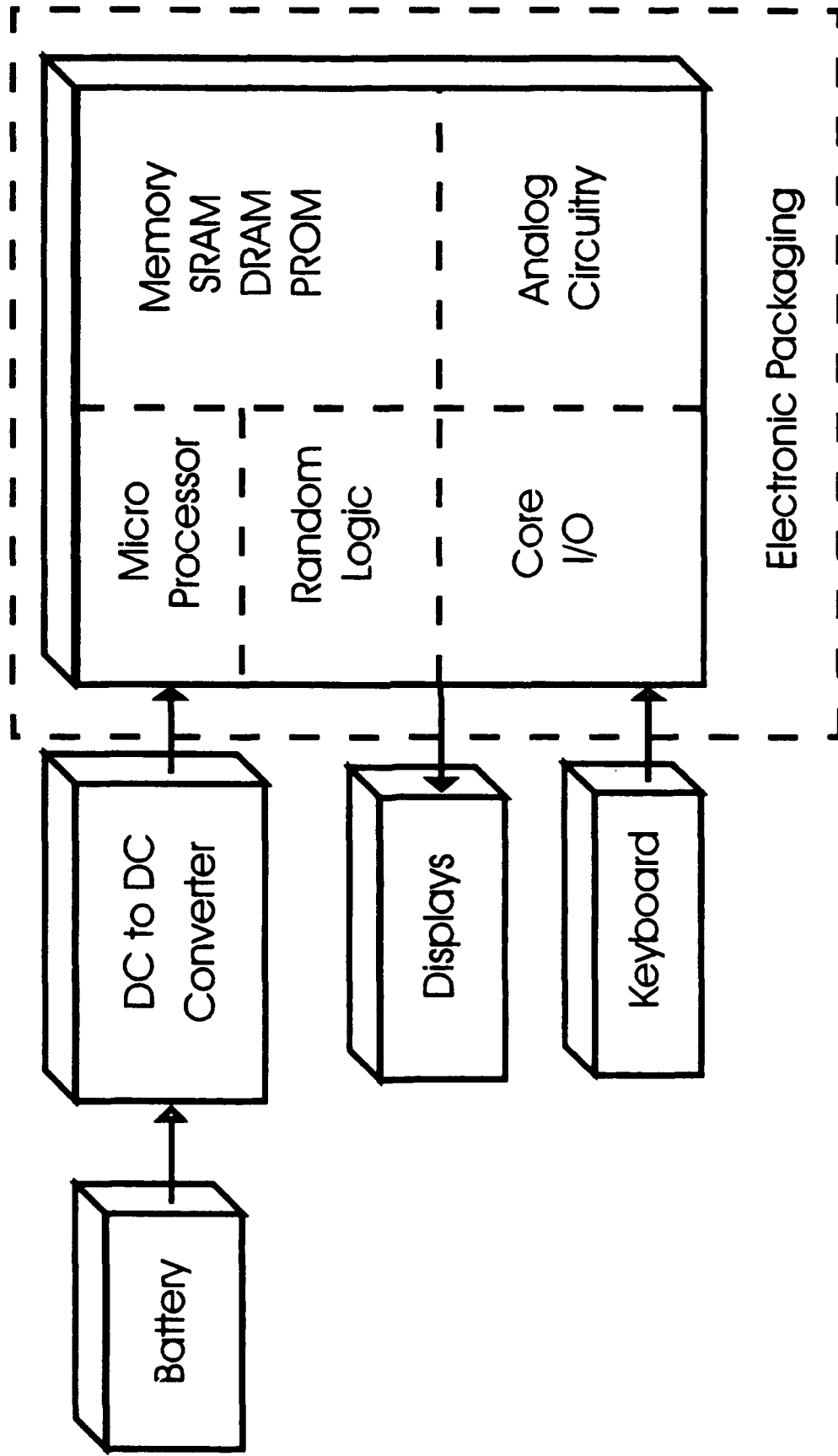


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# LOW POWER MUST BE ADDRESSED FROM AN ENTIRE SYSTEM POINT OF VIEW



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## POWER REDUCTION - GENERAL



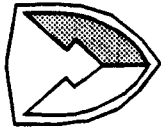
ARMY  
MATERIEL COMMAND

- Sleep And Idle Clock Modes
- Power Gating
- Reduced Voltage
- Reduced Load Capacitance
- Advanced Packaging



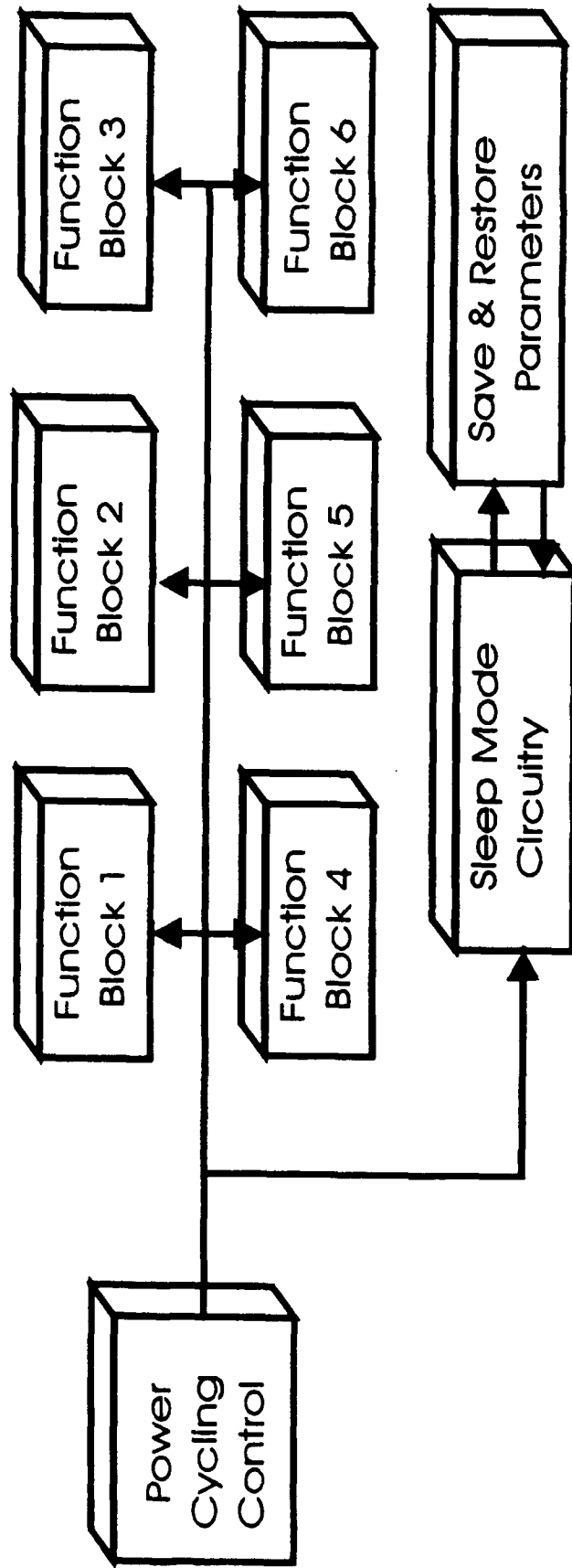
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# POWER CYCLING



ARMY  
MATERIEL COMMAND

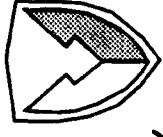
System should be partitioned to provide power savings thru the use of power cycling or sleep mode circuits. Good partitioning permits most functions to be powered down.





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# POWER REDUCTION STRATEGY



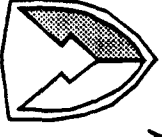
ARMY  
MATERIEL COMMAND

- 
- Microprocessor  
Software Controlled Power Management
  - Random Logic  
Adaptive Clocking Schemes  
Clock Idle Mode  
Gated Clock  
Power Cycling  
Design Synthesis For Optimization
  - Clocking Schemes  
Gated Clock Distribution  
Clock Frequency Control  
Control Skew To Eliminate Glitches



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# POWER REDUCTION STRATEGY



ARMY  
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- Memory

## S-RAM

Multi-Divided Memory Structure

Load Optimization

Functional Block Gating

## D-RAM

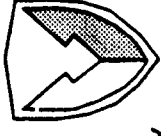
Decrease Required Refresh Frequency





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# POWER REDUCTION STRATEGY



ARMY  
MATERIEL COMMAND

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- Peripherals

- Simplify Peripheral I/O

- Eliminate Keyboard  
Coded Inputs  
Voice Activation

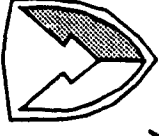
- Eliminate Displays Where Feasible  
Display On-Demand Only  
Shared Displays  
Simplified Visuals

- Analog Circuitry
  - Combine With Digital Circuitry
  - Use Digital Power Supply



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# POWER REDUCTION STRATEGY



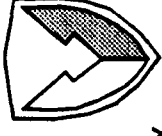
ARMY  
MATERIEL COMMAND

- **DC To DC Converter**  
**Improve Efficiency**  
**Eliminate Converters Where Feasible**  
**Direct Battery Operation**  
**(Watch Applications)**  
**Combined Digital And Analog Power Supplies**  
**(Digital +3V, 0V; Analog +3V, -3V)**



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## OTHER FACTORS



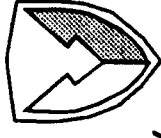
ARMY  
MATERIEL COMMAND

- Aggressively Scaled Submicron CMOS
- Insulating Substrates
- Dominant Power Mode (Operating vs Standby)



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# CONCLUSIONS



ARMY  
MATERIEL COMMAND

- Develop And Promulgate A Power Efficient Culture
- Low Power Systems And Components, In General Are More Costly And Probably Less Robust
- Need Comprehensive Design Tools
- Potential Efforts
  - Engineering Handbook:
    - Applications Guide For Systems, Boards, Modules, Microcircuits
  - Pilot Demo Program
- Commercial Spin-On
  - Adopt Methods, Architectures, Components

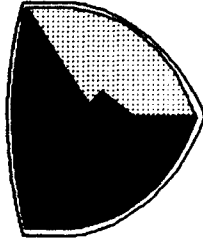
# NOTES

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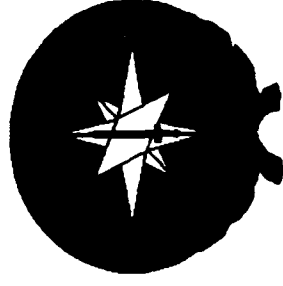
**U.S. ARMY COMMUNICATIONS-  
ELECTRONICS COMMAND  
(CECOM)**

**AMC BATTERY FOCAL POINT**

**AMC**



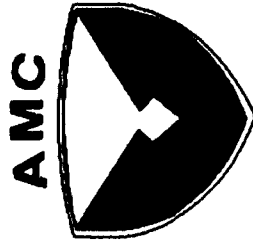
# **BATTERY PROGRAM**



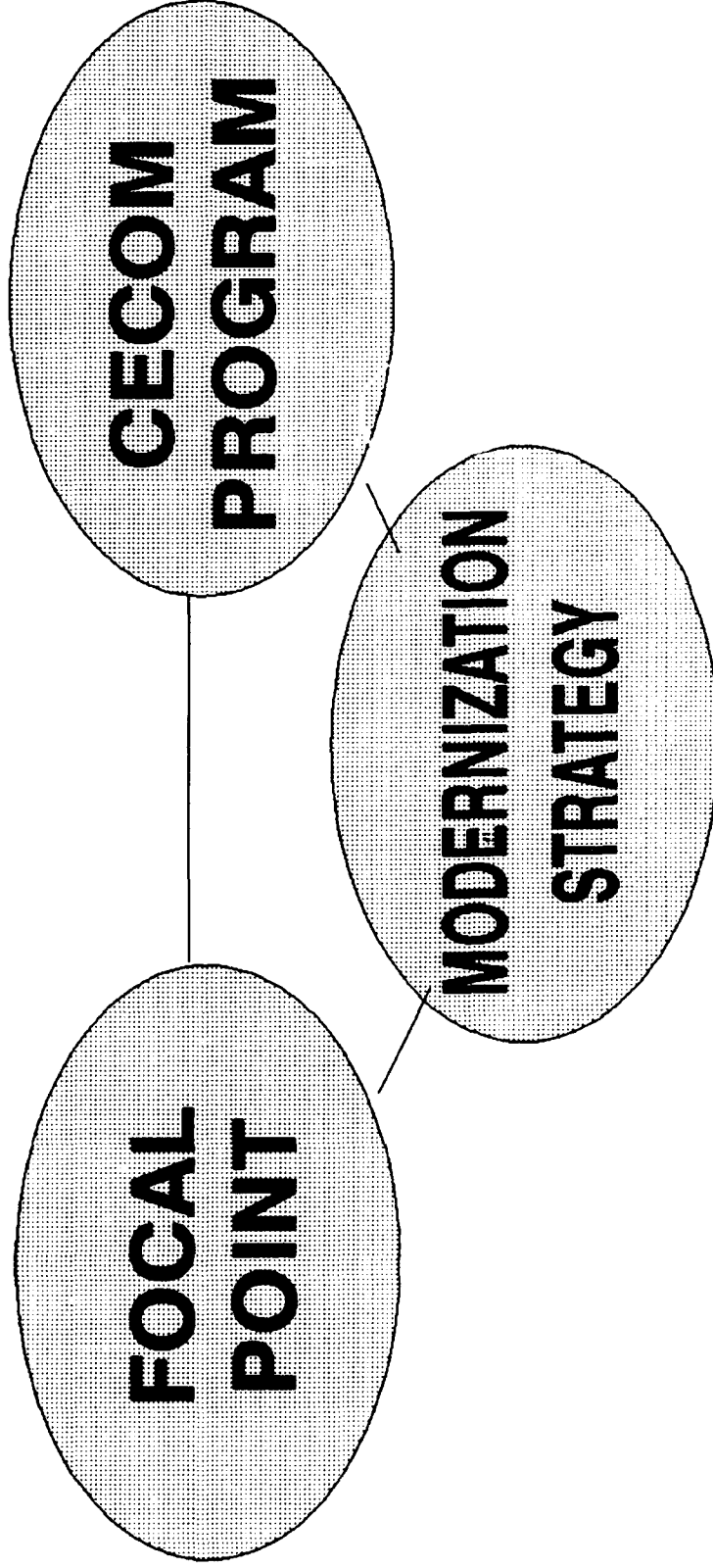
**MR. RICHARD RIZZO**

**US ARMY COMMUNICATIONS-  
ELECTRONICS COMMAND  
SYSTEMS MANAGEMENT DIRECTORATE**

**UNCLASSIFIED**



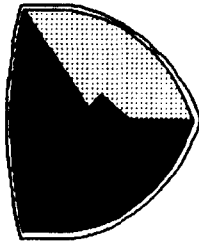
# **POWER SOURCES** **INITIATIVES**



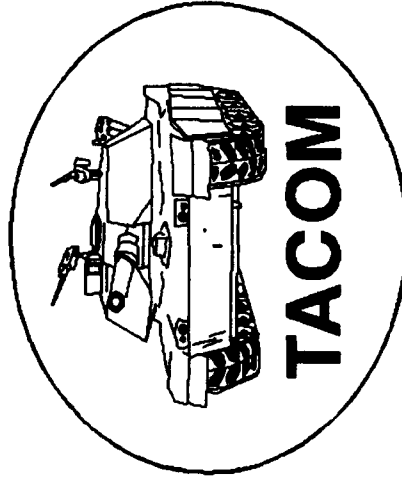
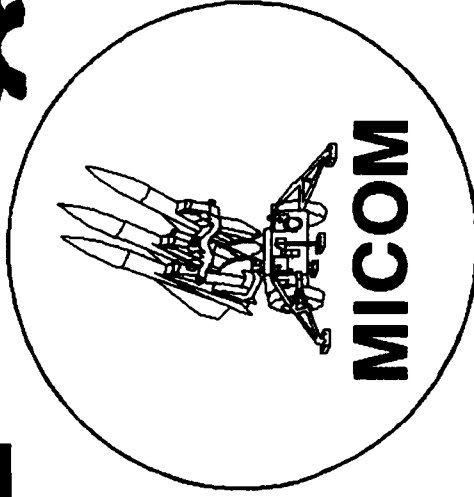
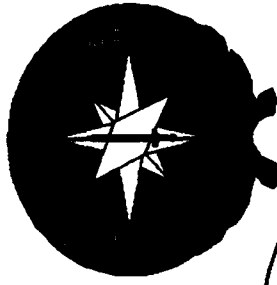
## **REDUCE O&S COSTS**



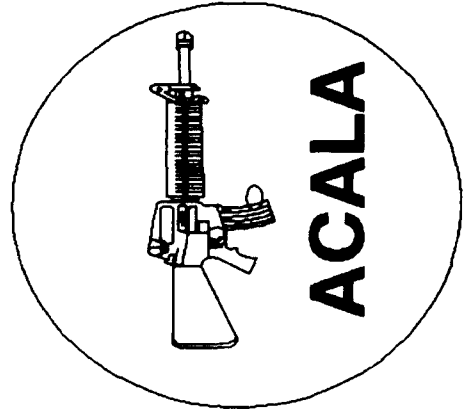
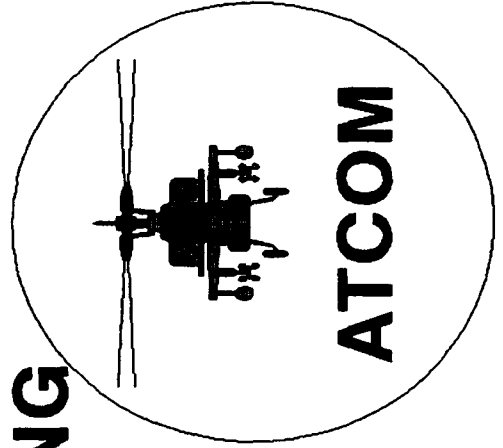
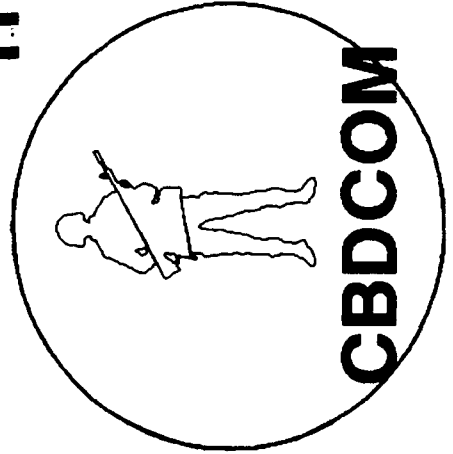
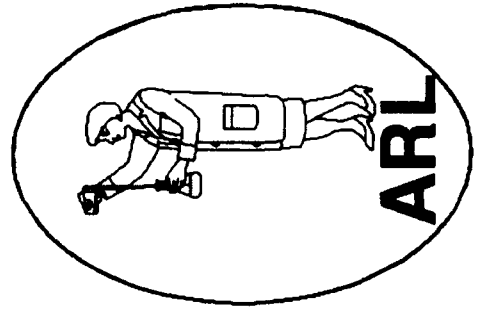
AMC



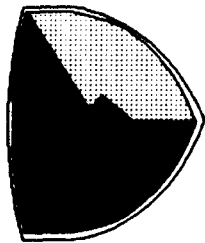
# BATTERY MANAGEMENT - THE WAY IT WAS



EVERYONE DOING THEIR OWN  
THING



**AMC**



**REDUCE**

**O&S**

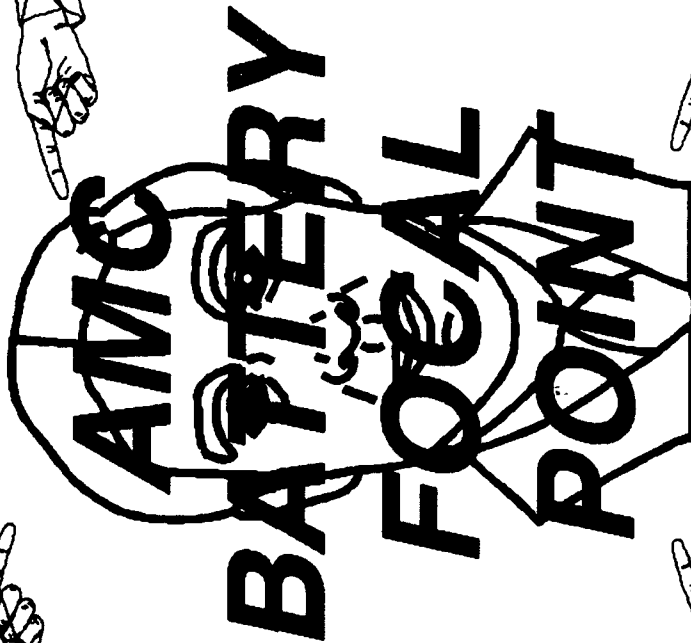
**COSTS**



**COORDINATE**

**AMC BATTERY**

**EFFORTS**



**REPRESENT**

**AMC**

**BATTERY**

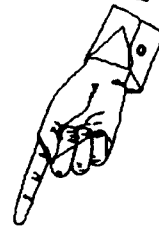
**PROGRAM**



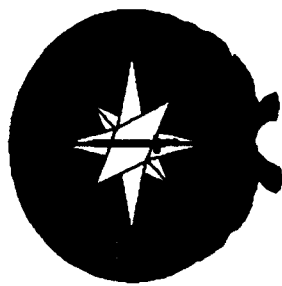
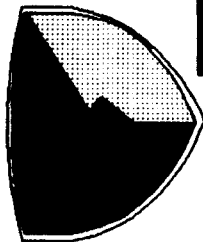
**ARMY**

**MODERNIZATION**

**STRATEGY**



AMC



# STEERING COMMITTEE FUNCTIONS TEAM APPROACH

**CHAIR - CECOM**

ARL

TECOM

ATCOM

AMC

TACOM

MICOM

BATTERY

TEAM

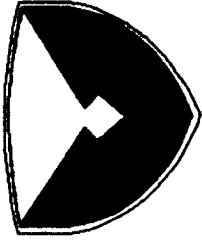
IOC

CBDCOM

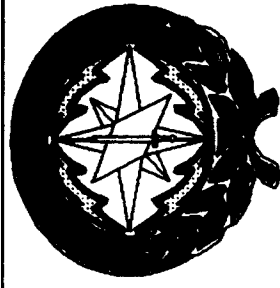
STRICOM

USASAC

- ▶ IMPROVE ARMY'S BATTERY AND BATTERY RELATED PROGRAM
- ▶ REDUCE O&S COSTS
- ▶ COORDINATE, EXCHANGE DATA/INFO

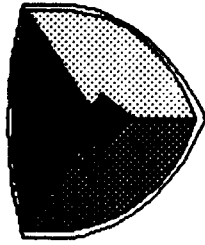


# AMC BATTERY STEERING COMMITTEE

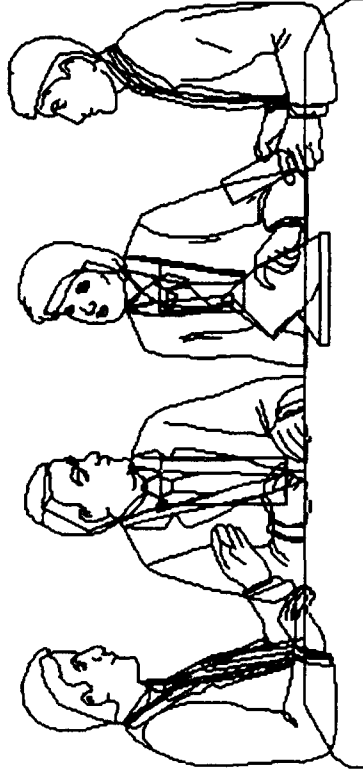
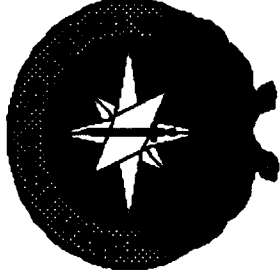


<u>MSC</u>	<u>POC</u>	<u>TELEPHONE</u>
CECOM (CHAIR)	RICH RIZZO	908-532-8941
ARL	DR. HAL CHRISTOPHER	908-544-4246
ATCOM	GIL KRENER	314-263-1100
CBD COM	TIM PEDRICK	410-671-5601
IOC	RUTH DELL	717-267-8474
MICOM	DR. BARRY ALLEN	205-876-3732
STRICOM	ARCHIE DULEY	407-381-8274
TACOM	JOHN BUSH	810-574-5297
TACOM (LOG)	ROSCOE SPENCER	309-782-8045
TACOM (RDEC)	CLIFF SHOOK	201-724-4378
TECOM	MAJ CRAIG KENT	410-278-1329

**AMC**

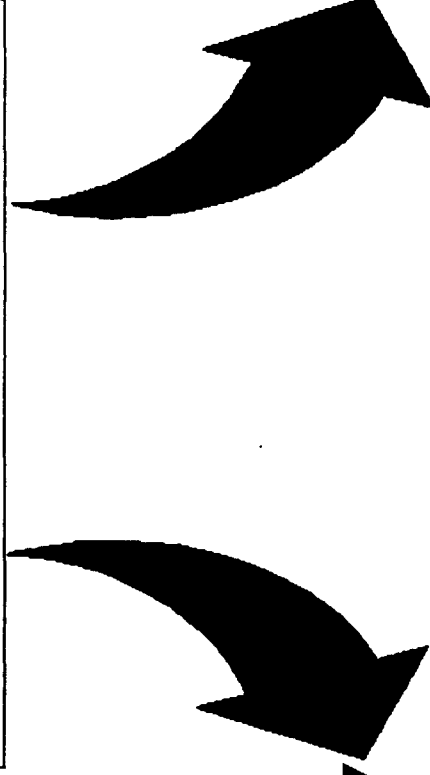


# **CECOM BATTERY OFFICE**

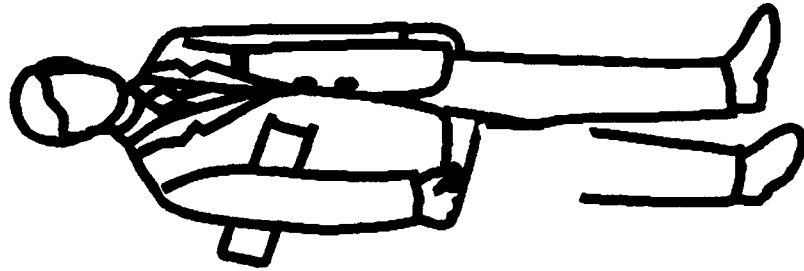
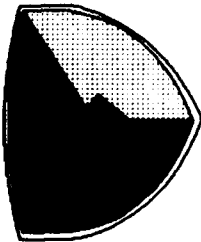


**MANAGE  
CECOM  
BATTERY  
PROGRAM**

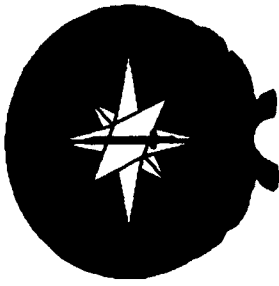
**AMC  
BATTERY  
FOCAL  
POINT**



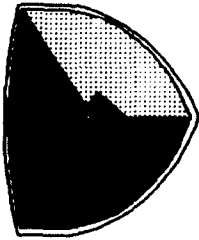
AMC



# CECOM BATTERY PROGRAM

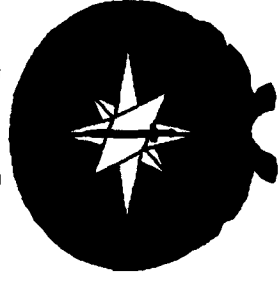


AMC



## OVERALL GOALS

## CECOM BATTERY PROGRAM



**TODAY**

**MILITARY  
UNIQUE  
TECHNOLOGY**

**DEDICATED  
PRODUCTION  
BASE**

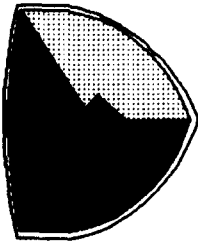
**HIGH  
O&S  
COSTS**



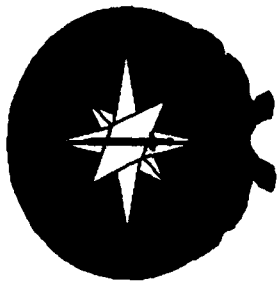
**TOMORROW**

- 1. LOWER O&S  
COSTS**
- 2. IMPROVED  
PERFORMANCE**
- 3. DUAL USE TECH**
- 4. STANDARDIZED**
- 5. SAFE**
- 6. REDUCED DISPOSAL  
COST**

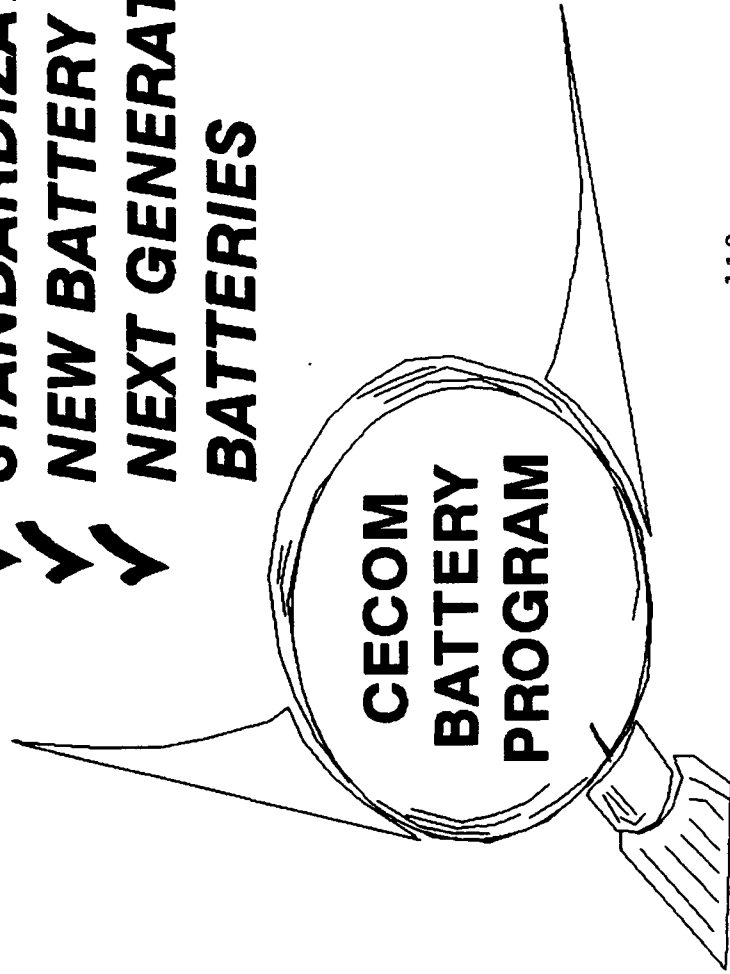
AMC



# **FOCUS - REDUCE O&S COSTS**

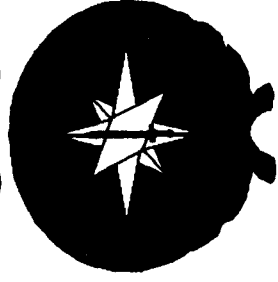


- ✓ DESIGN SOLUTIONS
- ✓ STANDARDIZATION
- ✓ NEW BATTERY CHARGERS
- ✓ NEXT GENERATION BATTERIES

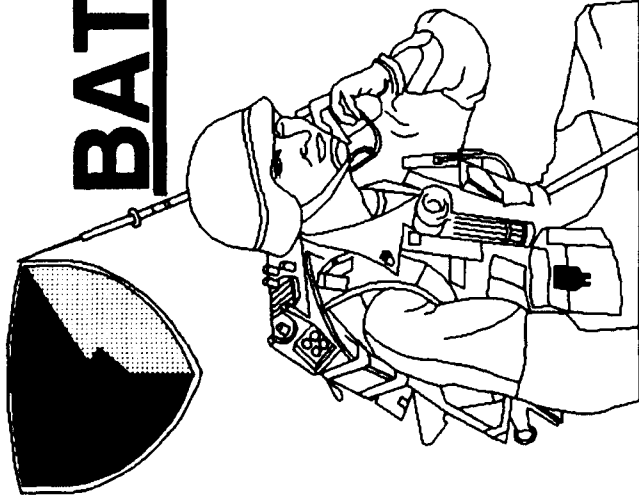




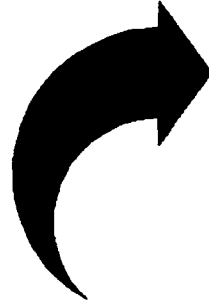
AMC



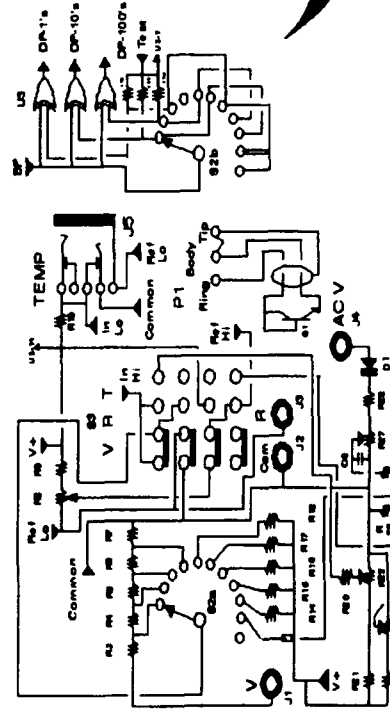
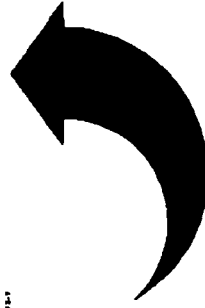
# BATTERY COST DRIVERS



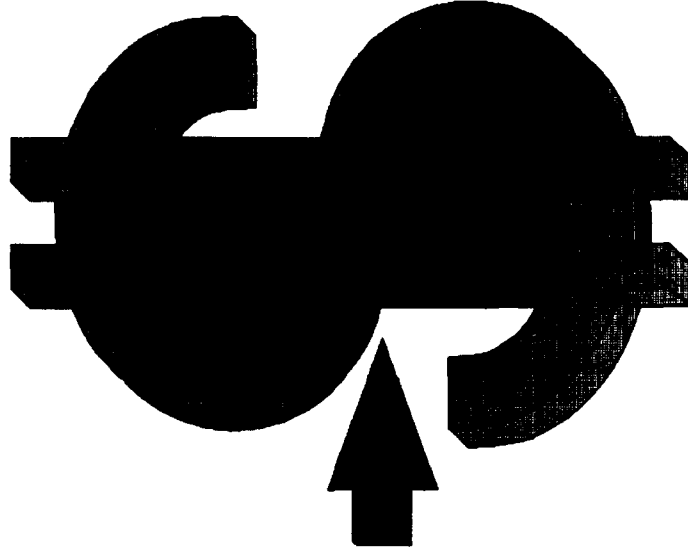
**USER  
REQUIREMENTS**



**MILITARY  
UNIQUE  
BATTERIES**

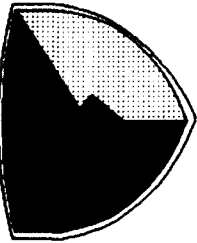


**DESIGN SOLUTIONS**

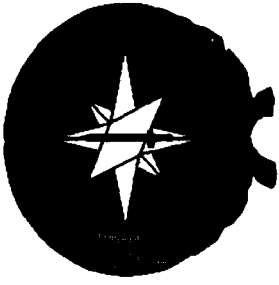


**O&S  
COSTS**

AMC



# SYSTEM DESIGN INFLUENCES



**INDUSTRY**

**POWER**

**MANAGEMENT**



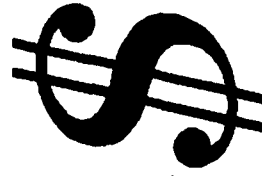
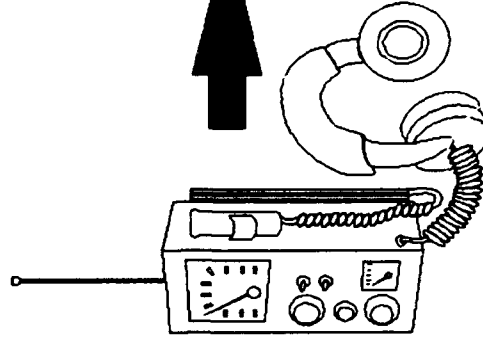
**BATTERY**

**TRADE OFFS**



**REQUIREMENTS**

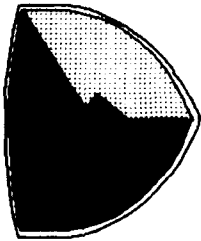
**IN ORD**



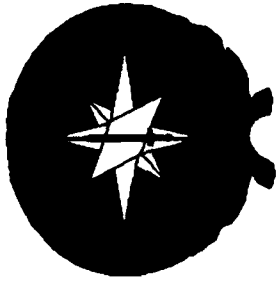
**O&S  
COSTS**

**GOVERNMENT**

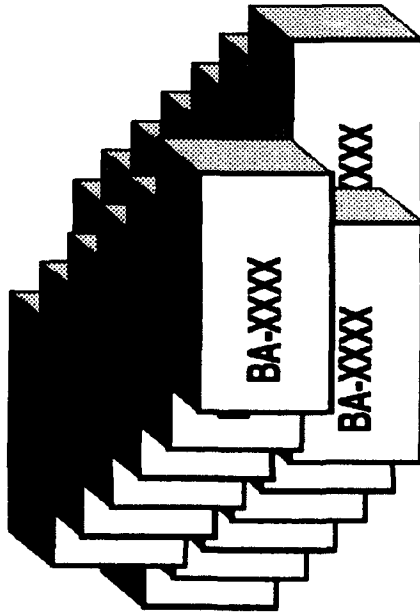
AMC



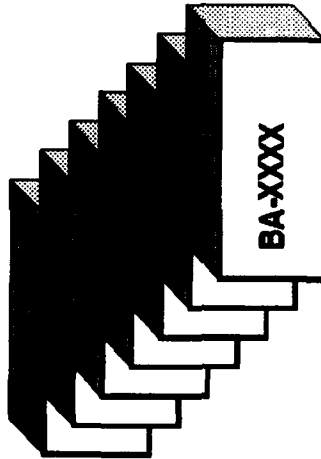
# C/E BATTERY STANDARDIZATION



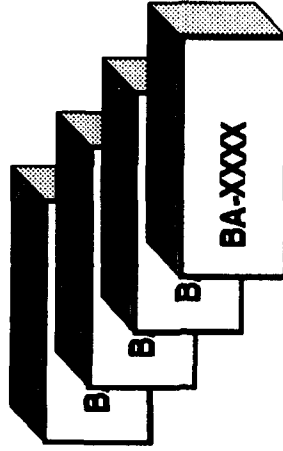
YESTERDAY



TODAY



TOMORROW



UNCONTROLLED  
PROLIFERATION

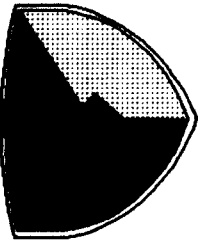
12 STD LITHIUM  
BATTERIES

5 PRIMARY LITHIUM  
BATTERIES

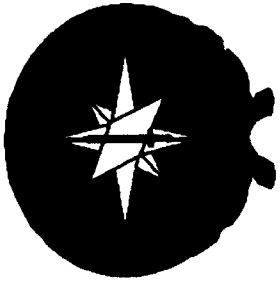
15+  
RECHARGEABLE  
BATTERIES

3 RECHARGEABLE  
BATTERIES

AMC



# **BATTERY STANDARDIZATION GOALS**



**REDUCE NUMBER  
OF BATTERIES**

**ONE BATTERY  
PER VOLTAGE**

**INFLUENCE END  
ITEM DESIGN**

**ELIMINATE BATTERY  
PROLIFERATION**

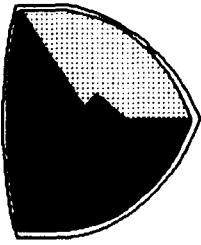
**REDUCE BATTERY  
RELATED O&S  
COSTS**



**STANDARD  
CHEMISTRIES &  
CONFIGURATIONS**



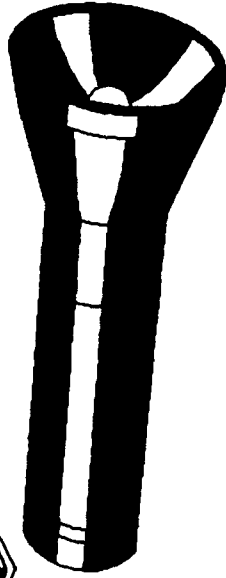
AMC



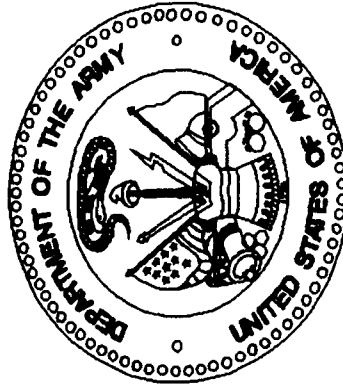
# BATTERY SELECTION



COMMERCIAL  
OFF THE SHELF  
(COTS)



BATTERIES  
MILITARY PREFERRED  
BATTERY LIST

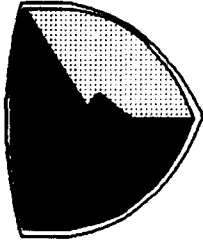


(BA-5590, BA-5588,  
BA-5567, BA-5847, BA-5372,  
BB-590, BB-588, BB-2847)



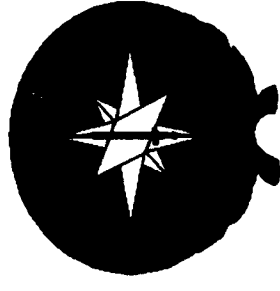
**NO  
UNIQUE**

AMC



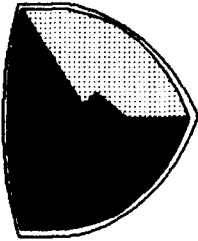
# **POWER SOURCES**

## **STATEMENT OF WORK**



- ✓ USE OF POWER MANAGEMENT
- ✓ USE OF CONSUMER OR MILITARY  
PREFERRED BATTERIES
- ✓ BATTERY ASSIGNMENT PROCESS
- ✓ INCORPORATED IN ALL NEW DESIGN AND  
PRODUCT IMPROVEMENT CONTRACTS

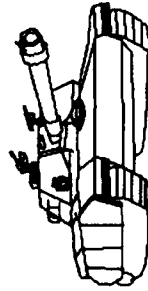
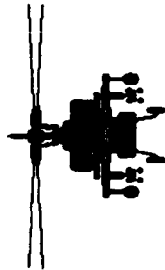
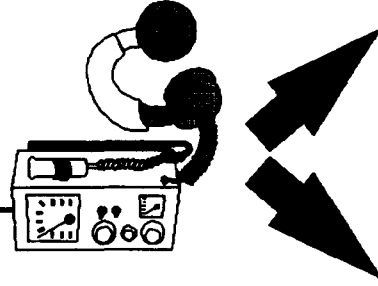
AMC



# BATTERY CHARGER MODERNIZATION

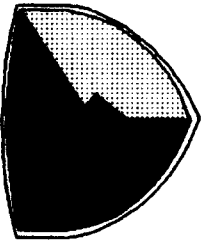


GOAL: COST EFFECTIVE MODERNIZATION  
OF THE BATTERY CHARGER INVENTORY

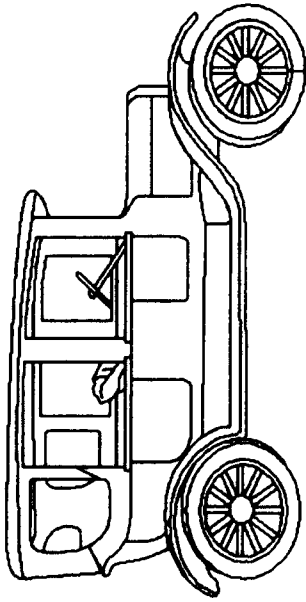


<u>UNIT LEVEL</u>	<u>BATTERY SHOP</u>	<u>UNIT LEVEL</u>	<u>BATTERY SHOP</u>
* "FLEET" STYLE	* AUTOMATIC	* PORTABLE	* AUTOMATIC
* LOW COST	* PROGRAMMABLE	* DUAL BATTERY	* PROGRAMMABLE
* COTS	* MULTIPLE BATTERY	CHARGE ABILITY	* MIN OF 5 BATTERY
	CHARGE ABILITY	* 2 HR CHARGE	CHARGE ABILITY
	* COTS	* COTS	* 2 HR CHARGE
			* COTS

**AMC**

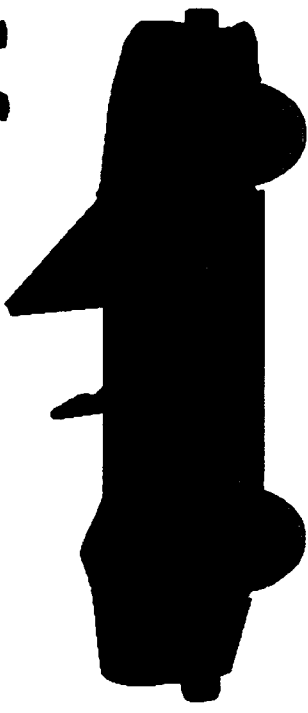


# **THE NEXT GENERATION**



## **TODAY**

- \* HIGH O&S COSTS**
- \* MILITARY UNIQUE**
- \* DISPOSAL COSTS**

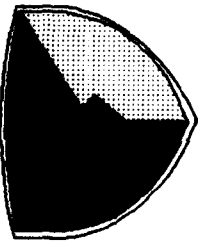


## **TOMORROW**

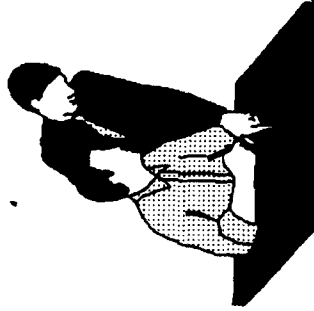
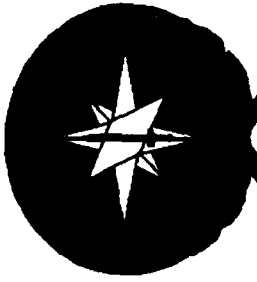
- \* REDUCED O&S COSTS**
- \* DUAL USE**
- \* REDUCED DISPOSAL COSTS**
- \* INCREASED CAPACITY**
- \* STATE OF CHARGE**



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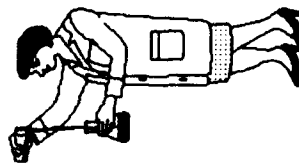


# THE ROAD TO THE NEXT PRIMARY BATTERY PROCUREMENT



## GOALS:

- ✓ DUAL USE
- ✓ STATE OF CHARGE
- ✓ 50% INCREASE IN CAPACITY



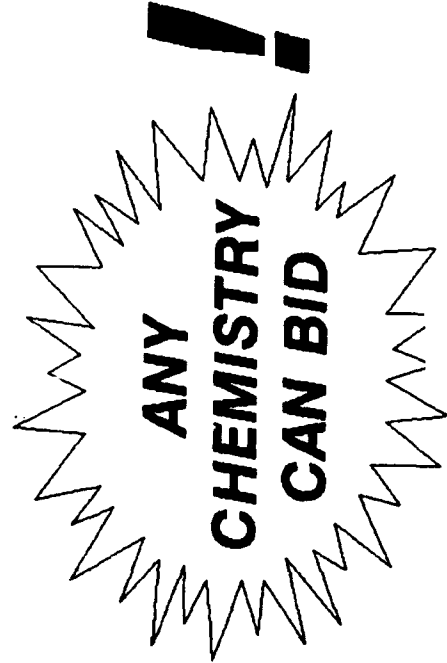
1994



SOLICITATION  
\* BEST VALUE  
\* BID SAMPLES  
\* RFP FORMAT

4Q96 - 1Q97

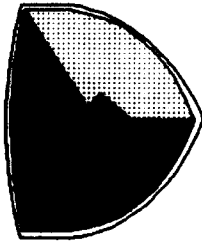
MULTIPLE YEAR  
CONTRACT AWARD



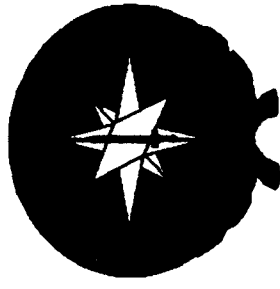
ANY  
CHEMISTRY  
CAN BID

NO NEW LITHIUM  
PROCUREMENTS  
PROJECTED UNTIL  
4Q96-1Q97

AMC



# **THE ROAD TO THE NEXT RECHARGEABLE GENERATION**



## **GOALS**



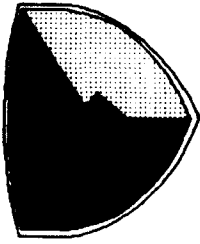
**NICKEL  
CADMIUM**

**NICKEL  
METAL  
HYDRIDE**

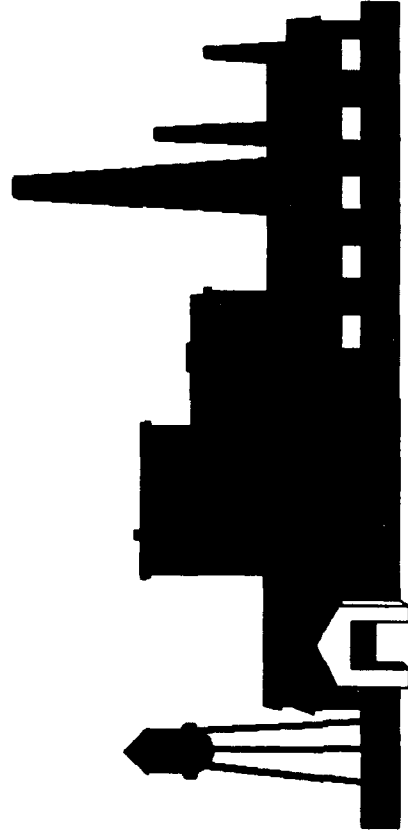
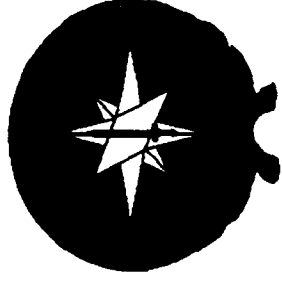
**LITHIUM**

**REDUCED WEIGHT  
COST EFFECTIVE  
IMPROVED PERFORMANCE  
LOW COST, PORTABLE CHARGING SYSTEM**

**AMC**

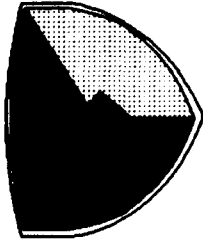


# **BUSINESS**



# **OPPORTUNITIES**

AMC



**1993 APBI**

**BUSINESS OPPORTUNITIES**

**STATUS**



**AWARDED:**

**Li/SO2 BUY OUT**

**AIRCRAFT OMNIBUS**

**VARIOUS MERCURY**

**BA-5372**

**VALUE:**

**\$34.8M**

**\$ 5.0M**

**\$ 0.2M**

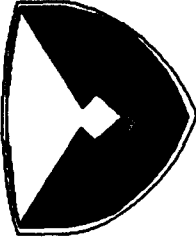
**\$13.1M**

**IN PROCESS:**

**RECHARGEABLE OMNIBUS**

**BA-6516**

AMC



## **BUSINESS OPPORTUNITY**

***BB-590, BB-588, BB-503, BB-516, BB-X847  
(INCLUDES CHARGER AND POWER SUPPLY)***

***CONTRACT METHOD: INDEFINITE DELIVERY/INDEFINITE  
QUANTITY (BASIC & 4 OPTION YEARS) BID SAMPLES***

**QUANTITIES: VARIES BY BATTERY**

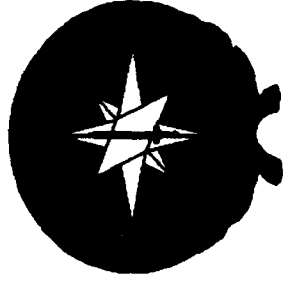
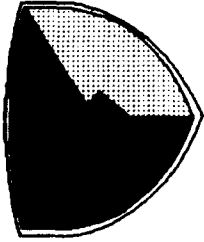
**SCHEDULE: SOLICITATION DATE - 1QFY95**

**AWARD DATE: FY95**

**ESTIMATED VALUE: \$28,000,000**

**POC: ROBERT REAGAN  
C31 ACQUISITION CENTER  
(908) 532-5645**

AMC



# **BUSINESS OPPORTUNITY**

## ***BB-542 (NiCd) REPAIR PROGRAM***

**CONTRACT METHOD: REQUEST FOR PROPOSAL**

**QUANTITIES: 346**

**SCHEDULE: SOLICITATION DATE - TBD**

**AWARD DATE: 2QFY95**

**ESTIMATED VALUE: \$280,000**

**POC: ROBERT REAGAN**

**C31 ACQUISITION CENTER  
(908) 532-5645**



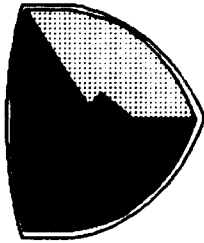
# NEXT GEN LITHIUM

# AIRCRAFT OMNIBUS

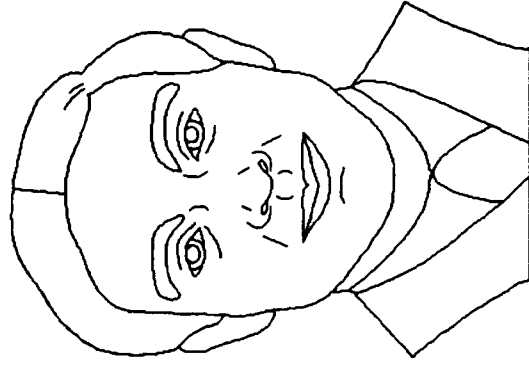
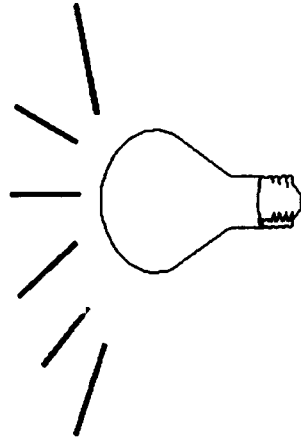
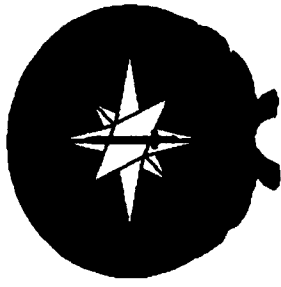
## CONTRACT LENGTH

**LEGEND:**      **BASE YEAR**      **OPTION YEAR(S)**

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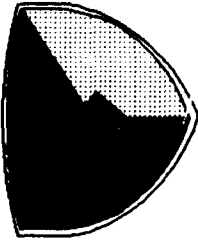


# HAVE A GOOD IDEA?

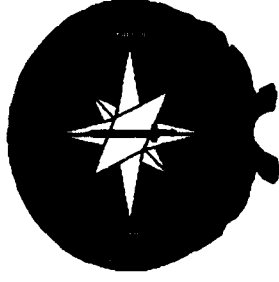




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**CALL**



**UNSOLICITED PROPOSALS:**

**NANETTE MULLENAX/  
SANDY VERMONT  
(908) 532-2671**

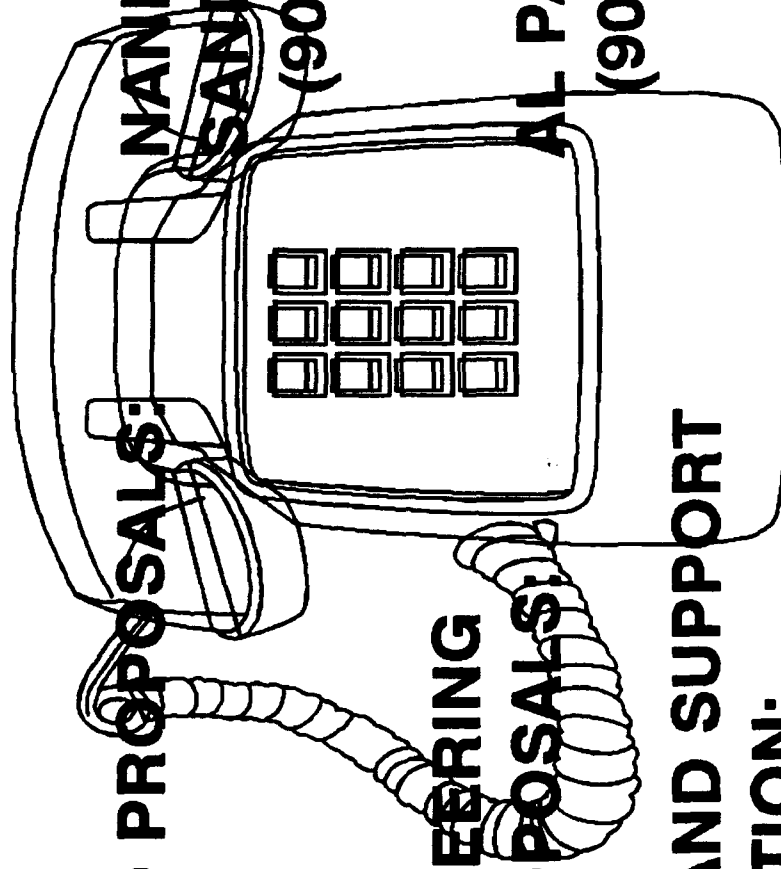
**VALUE ENGINEERING  
CHANGE PROPOSALS:**

**AL PALEY**

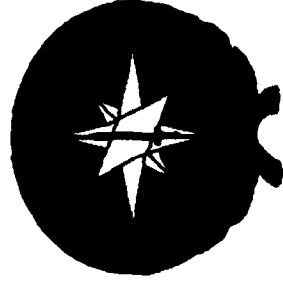
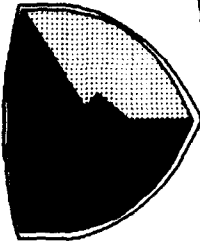
**(908) 532-2318**

**OR**

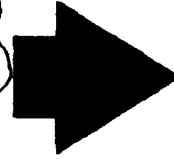
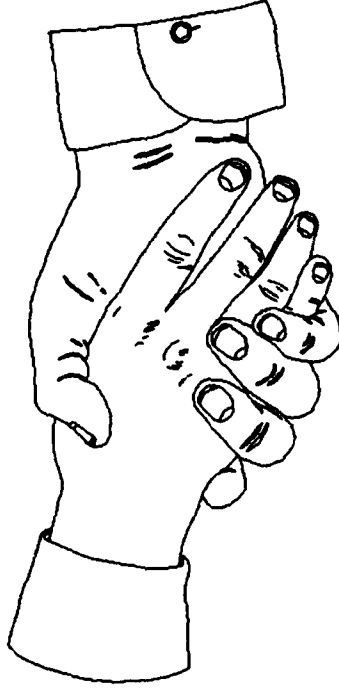
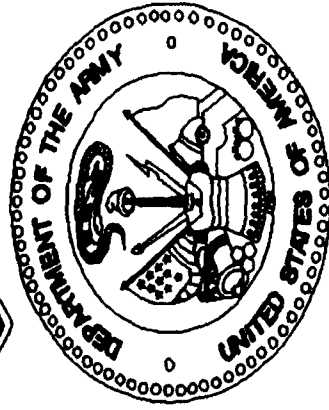
**OPERATING AND SUPPORT  
COST REDUCTION:**



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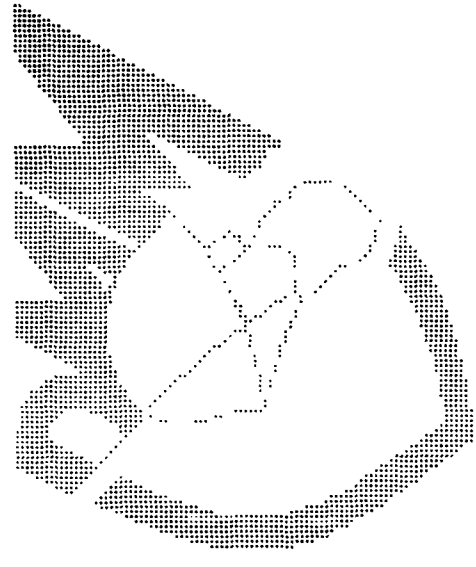
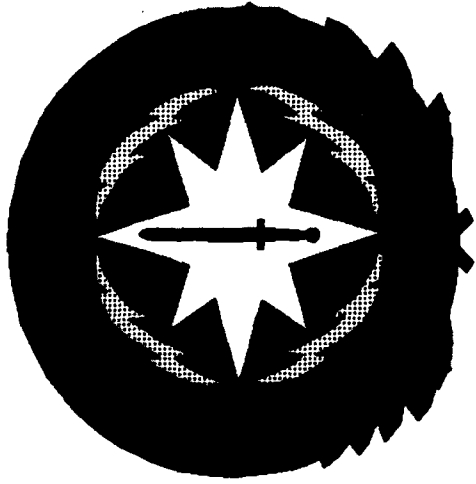


**WORKING TOGETHER**



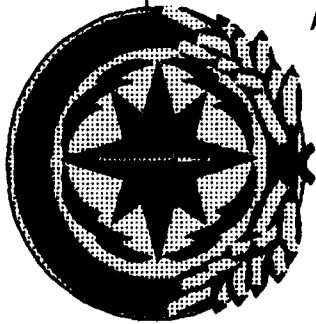
**TO HELP *THE* SOLDIER**

# NOTES

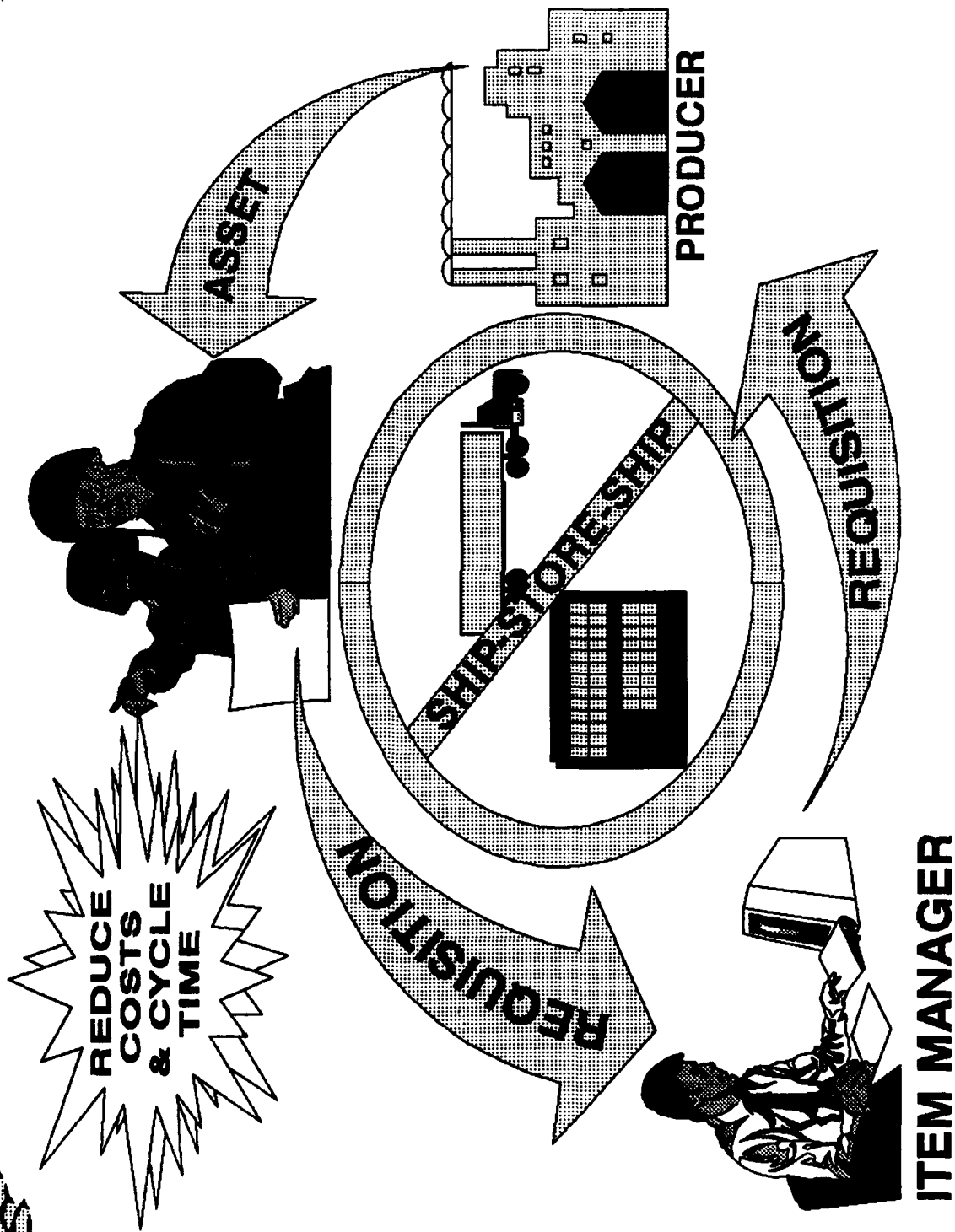
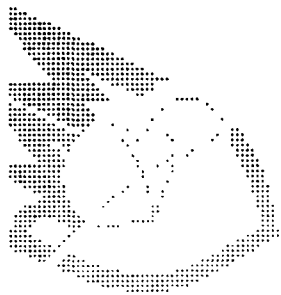


**U.S. ARMY**  
**COMMUNICATIONS-ELECTRONICS COMMAND**  
**DIRECT VENDOR DELIVERY**

**Directorate of Materiel Management**  
**Mr. Robert Pearson**  
**U N C L A S S I F I E D**  
**133**



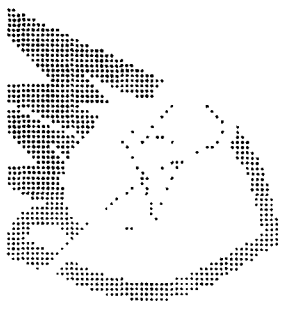
# DIRECT VENDOR DELIVERY



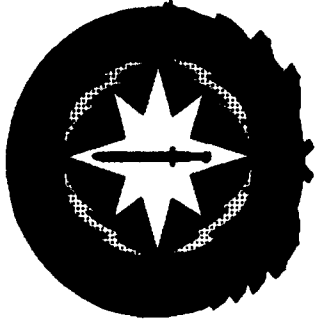


# Direct Vendor Delivery (DVD)

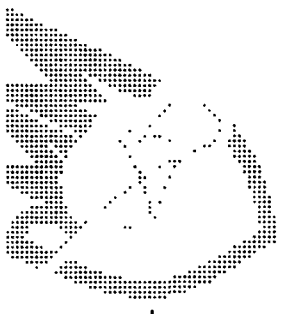
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- **Benefits**
  - Minimizes transportation costs
  - Reduces inventory at depots
  - Coupled with multiple year, packaged procurements
  - Moving towards use ANSI X.12 Electronic Data Interchange Standards
  - Requires joint effort (industry/government) to implement



# DVD--Batteries



- Implemented DVD test with UNICOR (FPI)
- Looking at modifying agreements on existing contracts
- Developing "requirements"
  - ✓ EDI
  - ✓ Inventory levels/storage
  - ✓ Packaging
  - ✓ Inspection and acceptance, etc.

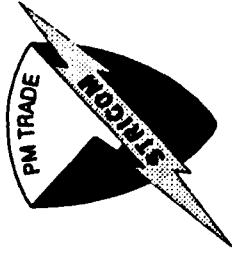
# NOTES



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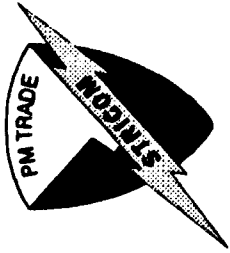
**U.S. ARMY SIMULATION,  
TRAINING AND  
INSTRUMENTATION COMMAND  
(STRICOM)**

**FUTURE EFFORTS**



# **BATTERY POWER FOR MANWORN PERSONNEL DETECTION DEVICE TRAINING SYSTEM**

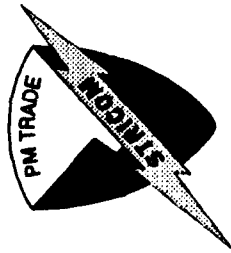
**UNCLASSIFIED**



**STEVE MILBURN**  
**DEPUTY PRODUCT**  
**MANAGER**  
**COMBAT SUPPORT**  
**TRAINING SYSTEMS**

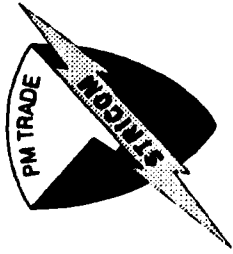
**HQ STRICOM**  
**ORLANDO, FL**

**UNCLASSIFIED**

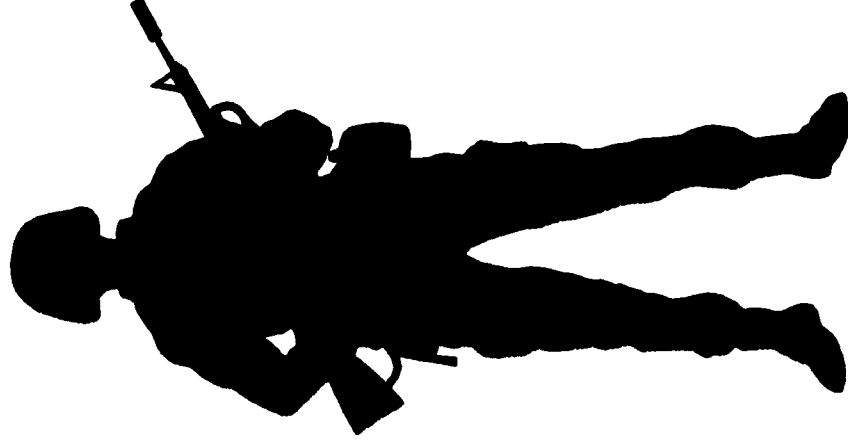


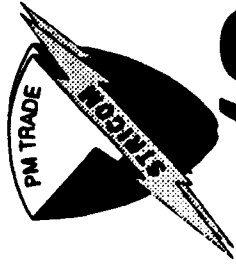
# The Army has a Training Device System



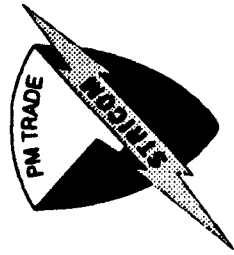


# ITS NAME IS SAWE/MILES II

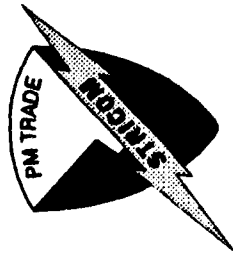




# **(SIMULATED AREA WEAPONS EFFECTS/MULTIPLE INTEGRATED LASER ENGAGEMENT SYSTEM)**

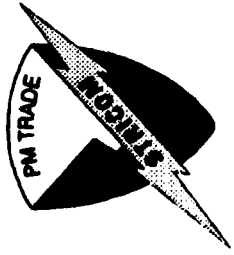


# **THE SAWE/MILES II SYSTEM HAS A MANWORN COMPONENT**

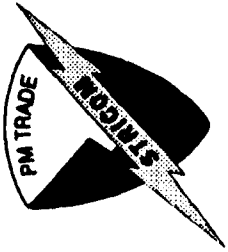


# **ITS NAME IS PDD (PLAYER DETECTION DEVICE)**





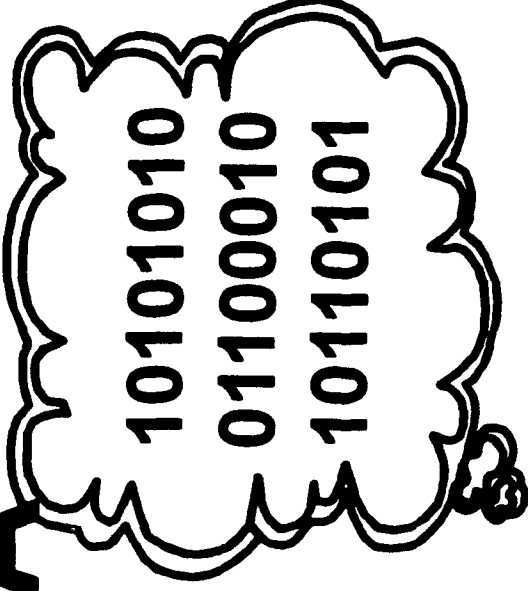
**THE PDD HAS A  
BATTERY  
ITS NAME IS  
BA5590/U**

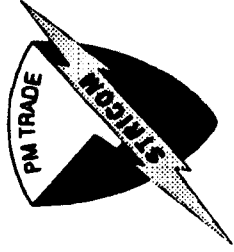


# **THE PDD DEALS**

## **WITH DATA**

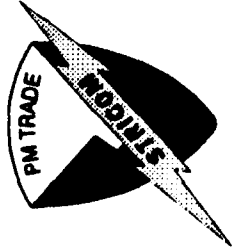
- Radio Frequency
- Transmissions
- Laser Reception
- Processing
- Digital Data Storage
- Position Location Polling
- Results/Timekeeping



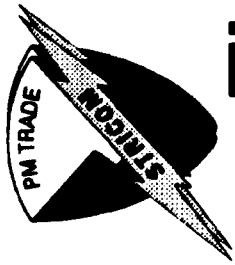


# **THE DATA IS ABOUT EVENTS AND SITUATIONS**

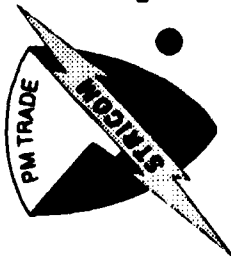
- **Position Location (Global Positioning System)**
- **Direct Weapon Engagement**
- **Hit/Kill Results (MILES)**
- **Indirect Weapons, Chemical, Biological and Nuclear Effects (SAWE)**



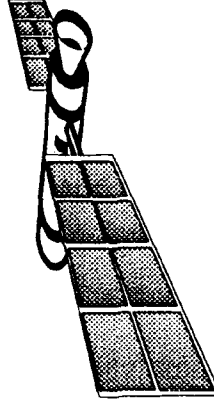
**THE SOLDIER WEARS  
THE PDD IN ADDITION  
TO ALL OTHER COMBAT  
EQUIPMENT. THE  
SOLDIER DOES HIS  
JOB IN A REALISTIC  
TACTICAL MANEUVER  
ENVIRONMENT**

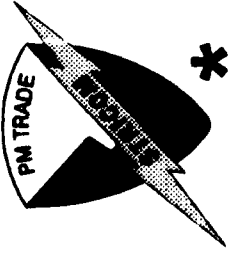


- **The PDD can "talk" to a CTC\* Data Collection and Analysis Instrumentation System when a DCI (Data Communication Interface) Device (small transceiver) is added.**
- **The PDD with a DCI makes an "Instrumented Player."**

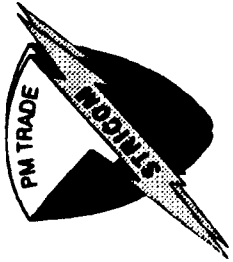


- The DCI gets its power from the PDD.
- The PDD components all draw on the same power source.
- The frequency of events, of position location reporting and event data reporting determine drain on the battery.



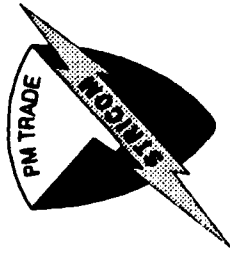


**\* Three Combat Training  
Centers (CTC):  
Combat Maneuver  
(Germany)  
Joint Readiness  
(FT Polk, LA)  
National Training Center  
(FT Irwin, CA)**

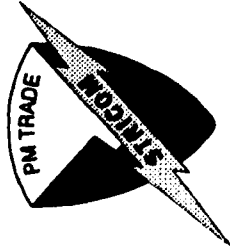


- **THE BA5590/U IS THE ONLY  
TYPE CLASSIFIED  
STANDARD BATTERY  
CURRENTLY AVAILABLE  
THAT SATISFIES ALL OF THE  
MINIMUM ESSENTIAL  
OPERATING AND COST  
PARAMETERS**

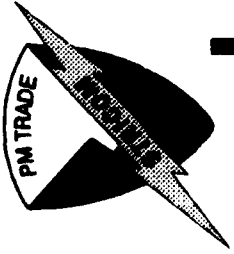




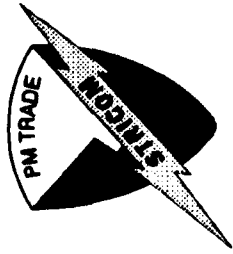
- **Power Output = 9.2w**
- **Size = Not as big as a brick**
- **Weight = Not heavier than 2.25 lbs**
- **Instrumented PDD Duty Cycle = 24 hrs minimum**
- **Cost = Under \$55 each**



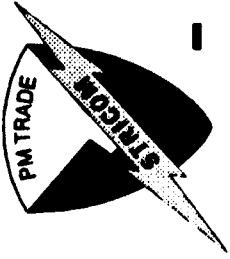
- **THE PDD IS BEING  
MODIFIED TO BETTER  
MEET SOLDIER  
FUNCTIONAL NEEDS**



- **Lighter**
- **Better Component Layout,  
Including Battery**
- **More User Friendly (e.g.,  
set-up in MOP- 4)**



- **THE NEW DOWNSIZED  
PDD'S BATTERY NEEDS  
TO CHANGE ALSO**



- **Lighter Weight (high power to weight ratio)**
- **Longer Power Life (longer amp life in context of "average" demand)**
- **Lower Cost**
  - ▶ **Function of annual procurement expense, either or both**



✓Lower price per battery

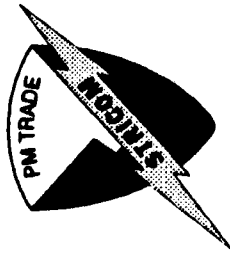
✓Longer life in operation

- Smaller Size and Smoother Configuration

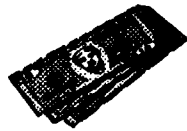
► Could be size and shape of common item soldier already carries (e.g. ammo magazine, first aid kit)



- ▶ **Human Engineering Factors (fits the training system)**
- **Easier to Handle, Connect, Carry and Dispose**

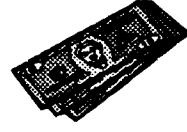


# PDD BATTERY CONSIDERATIONS & CHALLENGES

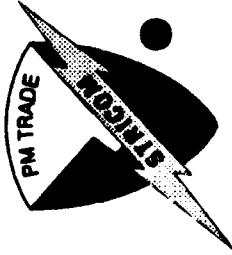


## "OUR DESIREMENTS"

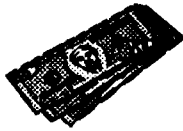
- Weight (lighter than 2.0 lbs each)



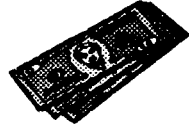




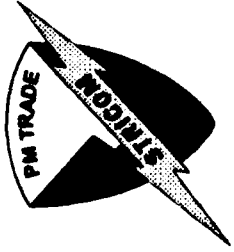
- Power (9.2w @ 12v/dc,  
"standard instrumented use"  
for MORE THAN 24 hrs)



- Cost (less than \$20 EACH)
- Configuration (example:  
shaped as a 30 Rnd  
"banana" magazine)



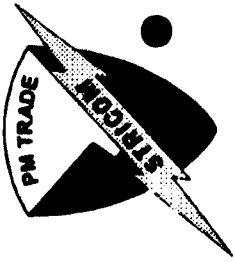
**\*Cost Impacts**



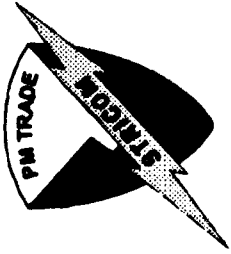
# **PDD BATTERY CONSIDERATIONS & CHALLENGES**

## ***"OUR DESIREMENTS" Cont'd***

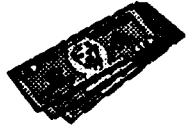
- **Environment Impact (low or no hazard - "drop and walk")**



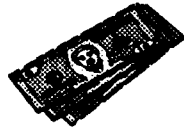
- **Ease of Use and Disposal**
  - **Connection access user friendly**
  - **Transportability (nothing special needed)**
  - **Durability (all weather/rough handling)**
  - **Disposal (simple/inexpensive, with no special handling)**



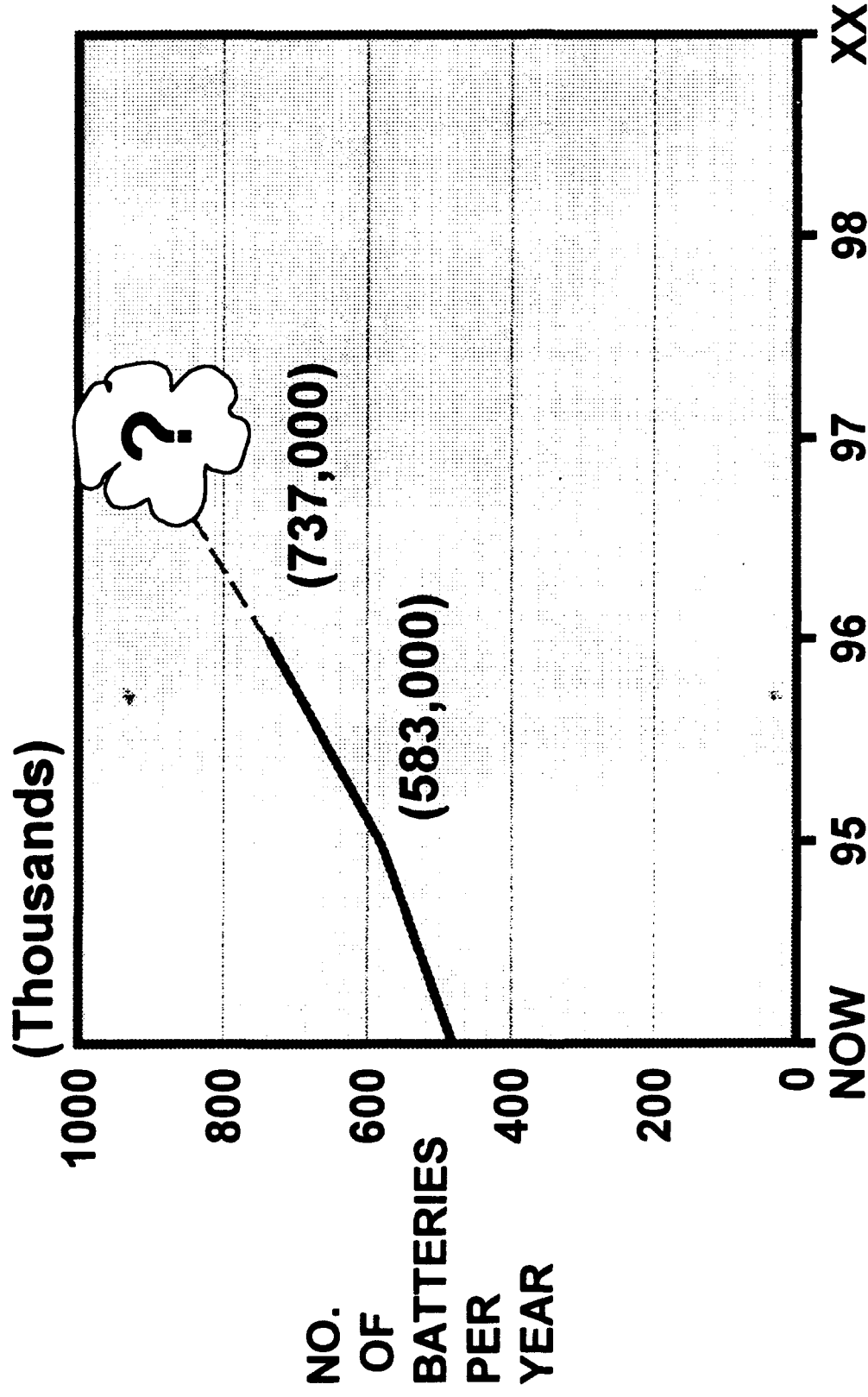
- **Safe (very!)**
- **Shelf Life (many months long and not heat/cold sensitive)**



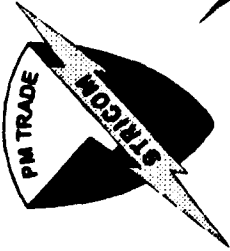
**\* Cost Impacts**



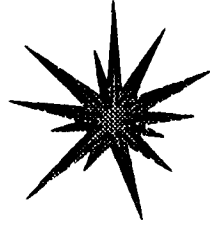
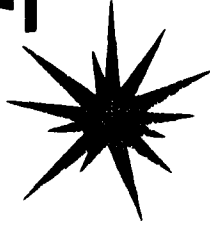
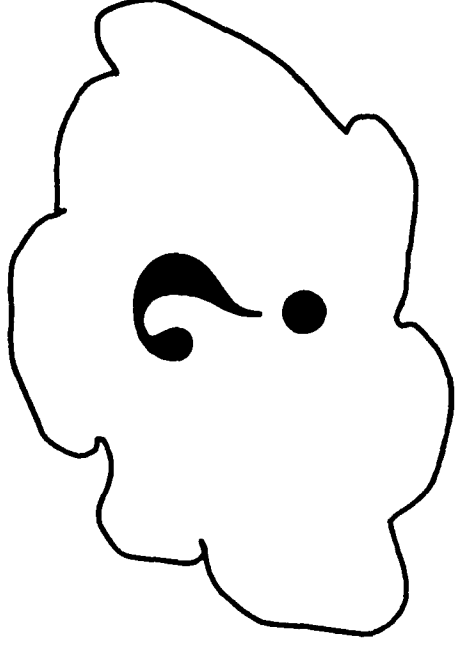
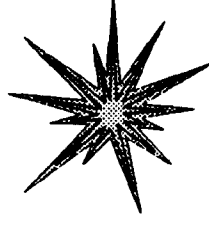
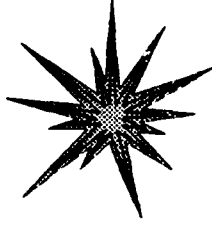
# WHAT IS THE MARKET POTENTIAL?



\* Figures are Rough Order of Magnitude (ROM) estimates based on planned equipment orders and usage experiences.



## **THE QUESTION**



**How many of our Army  
"desirements" can industry  
fulfill, when and to what  
extent?**

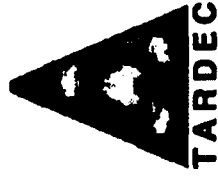
# NOTES

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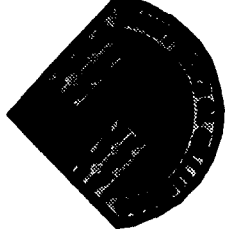
**U.S. ARMY TANK-AUTOMOTIVE  
AND ARMAMENTS COMMAND  
(TACOM)**

**BATTERY PROGRAM**





TANK-AUTOMOTIVE RD&E TECHNOLOGY CENTER

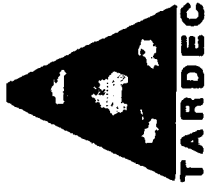


# POWER & ENERGY STORAGE REQUIREMENTS FOR MILITARY VEHICLES

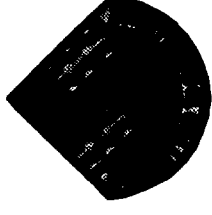
JOHN F. BUSH  
APPLIED ENGR & ROBOTICS  
DIVISION

(810) 574-5297  
DSN 786-5297  
FAX (810) 574-5008

UNCLASSIFIED

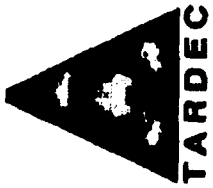


TANK AUTOMOTIVE RD&E TECHNOLOGY CENTER

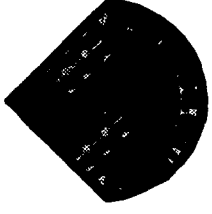


## VISION

To become a world class leader for tank-automotive electrical systems and to provide the soldier with the most advanced electrical systems at the lowest cost.

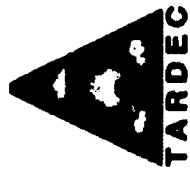


TANK AUTOMOTIVE RD&E TECHNOLOGY CENTER

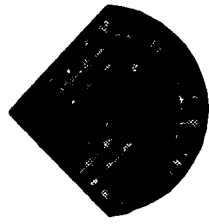


## **MISSION:**

To provide the most reliable and cost effective **\$**  
electrical systems and components. To **\$**  
improve fleet readiness, and reduce operating **\$**  
and support costs related to electrical power **\$**  
generation, regulation, storage, and  
distribution.

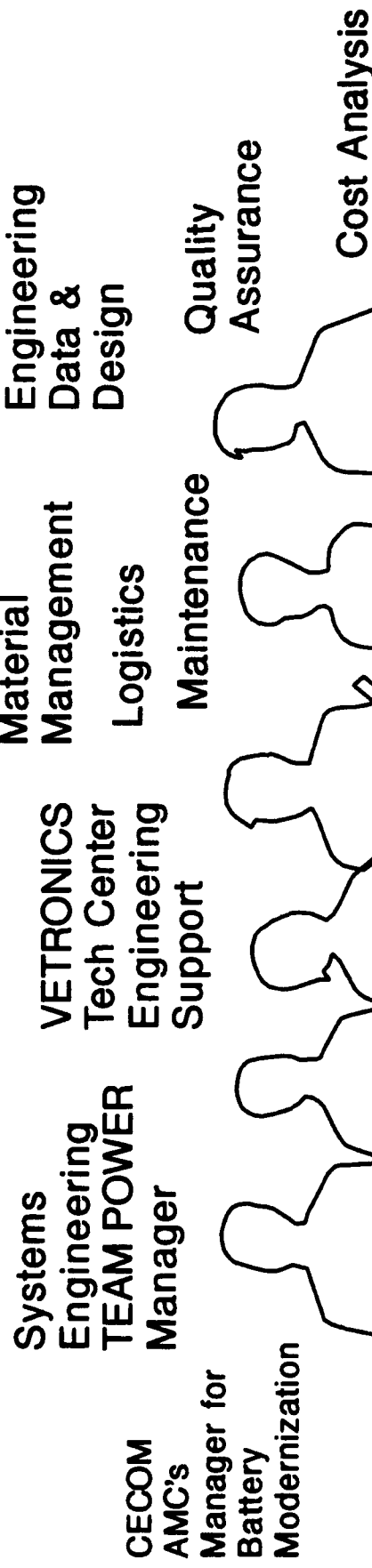


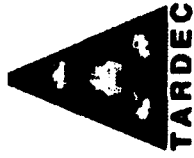
TANK AUTOMOTIVE RD&E TECHNOLOGY CENTER



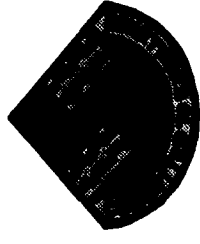
# TEAM POWER

## BATTERY TECHNOLOGY ORGANIZATION





TANK AUTOMOTIVE RD&E TECHNOLOGY CENTER



## ELECTRICAL POWER REQUIREMENTS FOR MILITARY VEHICLES



\* 24 VOLT ELECTRICAL SYSTEMS

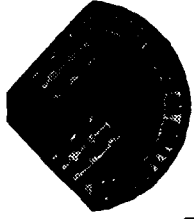
\* HIGH POWER FOR ENGINE STARTING

\* HIGH ENERGY DEMAND FOR SILENT  
WATCH OPERATIONS

\* OPERATE IN EXTREME TEMPERATURES (-40  
TO 115 DEGREE F)

\* INTERMITTENT OPERATION





## TANK-AUTOMOTIVE BATTERY PROGRAM

### OVERVIEW

#### THRUST

6TL PROCUREMENT STRATEGY

COMMERCIAL BATTERY USAGE

CAPACITOR STARTING SYSTEMS

SOLAR POWERED TRICKLE CHARGERS

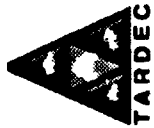
#### PAYOFF

DIRECT  
VENDOR  
DELIVERY

IMPROVE  
AVAILABILITY &  
DISPOSAL

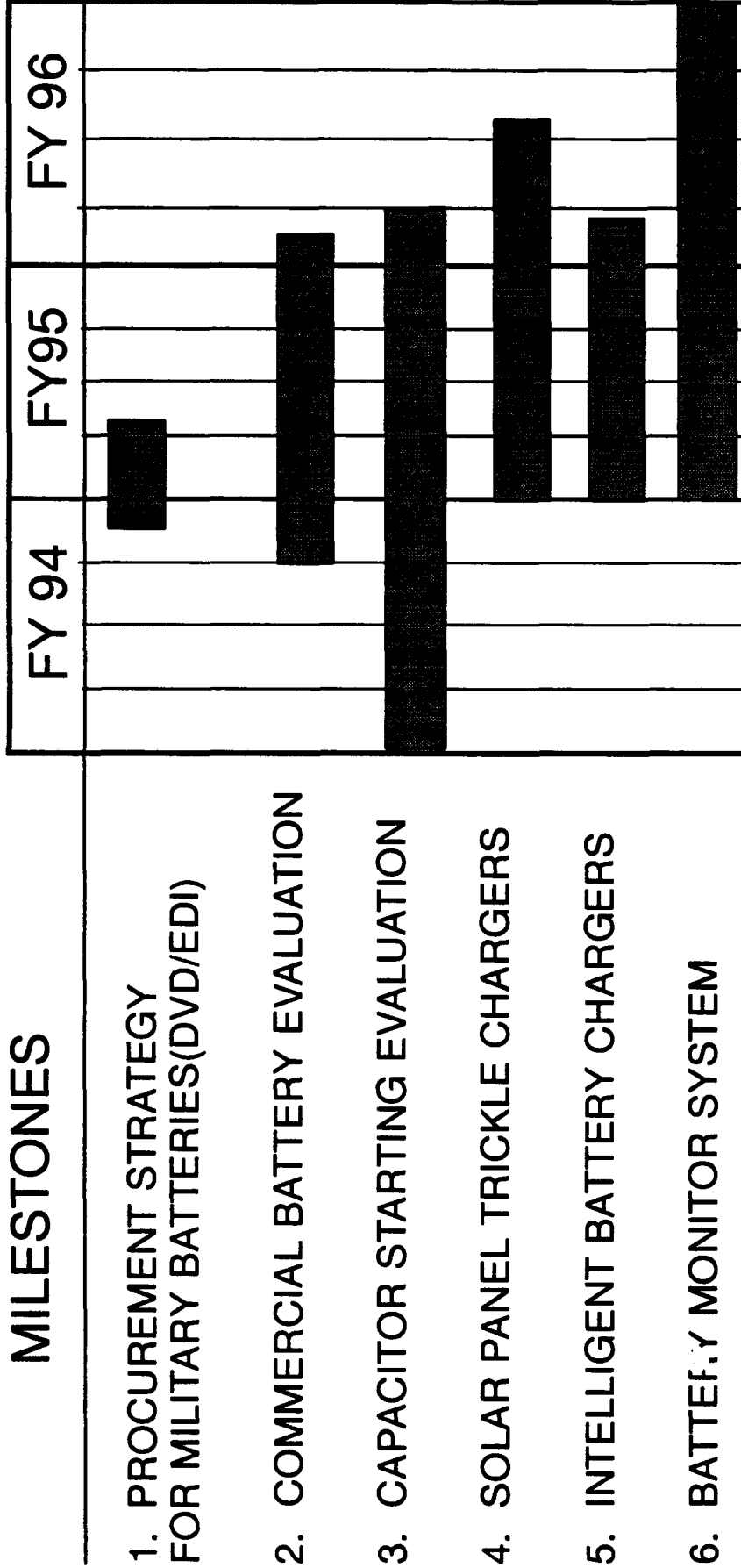
EXTEND  
BATTERY  
LIFE

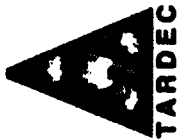
REDUCE  
BATTERY  
SULFATION



## BATTERY MODERNIZATION PROJECTS

### MILESTONES





TANK AUTOMOTIVE RD&E TECHNOLOGY CENTER



## COMMERCIAL BATTERY PROCUREMENT FORECAST

VEHICLE	BATTERY TYPE	FY 95	FY 96	FY 97
TACTICAL	FLOODED	184,000	177,000	174,000
COMBAT	SEALED	58,000	56,000	55,000
		<hr/>	<hr/>	<hr/>
		242,000	233,000	229,000

LEAD-ACID BATTERY TECHNOLOGY



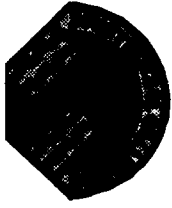


## BUSINESS OPPORTUNITIES

FY95	FY96	FY97
* SEALED L-A BATTERIES	* ULTRA CAPACITORS	* ADVANCED BATTERIES
* COMMERCIAL BATTERIES		
* BATTERY DVD TACOM DLA	* BATTERY CHARGERS	* STATE OF CHARGE METERS
	* SOLAR CHARGERS	* EV COMPONENTS



TANK AUTOMOTIVE RD&E TECHNOLOGY CENTER

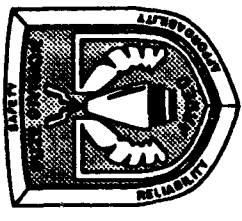


## *FUTURE REQUIREMENTS*

- \* HIGH POWER AND ENERGY DENSITY
- \* EXTENDED BATTERY SERVICE LIFE
- \* MAINTENANCE FREE
- \* ENVIRONMENTALLY SAFE



# NOTES



# **Fuze Power Supply Requirements**

**MR. ALAN C. REITER**

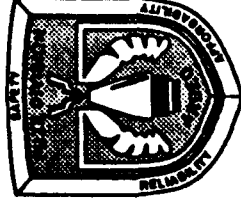
**TACOM / ARDEC / FUZE DIVISION**

**ADELPHI MD**

**UNCLASSIFIED**



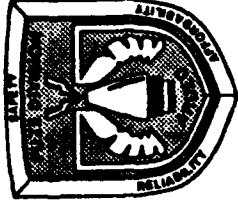
# Outline



- **Fuze Environment**
- **Fuze Power Supply Requirements**
- **Reserve Power Supplies Descriptions**
- **Growth Technology Areas**
- **Business Opportunities**



# Fuze Environment



**GENERAL:** One-shot after storage  
@ -51°C to +71°C

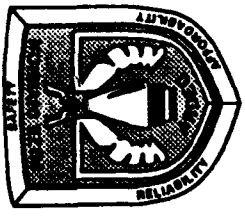
**ARTILLERY:** High spin rate & g-forces;  
short mission time

**MINE:** No acceleration forces;  
long mission time

**MISSILE:** Low spin rate & g-forces;  
moderate mission time



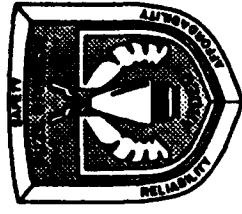
# Fuze Power Supply Requirements



- Integral, Not Replaced
- 10 to 20+ Years Shelf Life
- Quick Response/Rise Time  
Typically Milliseconds,  
Depending on Application
- Typical Operational Range  
-40°C to +60°C



# Types of Reserve Batteries



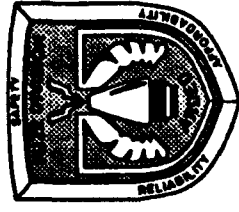
- Liquid Electrolyte  
Artillery  
Mines

- Thermal  
Mortars  
Rockets  
Missiles (G&C, too)





# **Liquid Electrolyte Conventional Reserve Batteries**



- **30+ Years Shelf-Life**
- **Pb/HBF<sub>4</sub>/PbO<sub>2</sub> Electrochemistry**
- **Bipolar Plate Cells, Unique Material**
- **Electrolyte in Separate Ampule**
- **Setback and Spin Activated**

AMPULE ASSEMBLY

SUMP

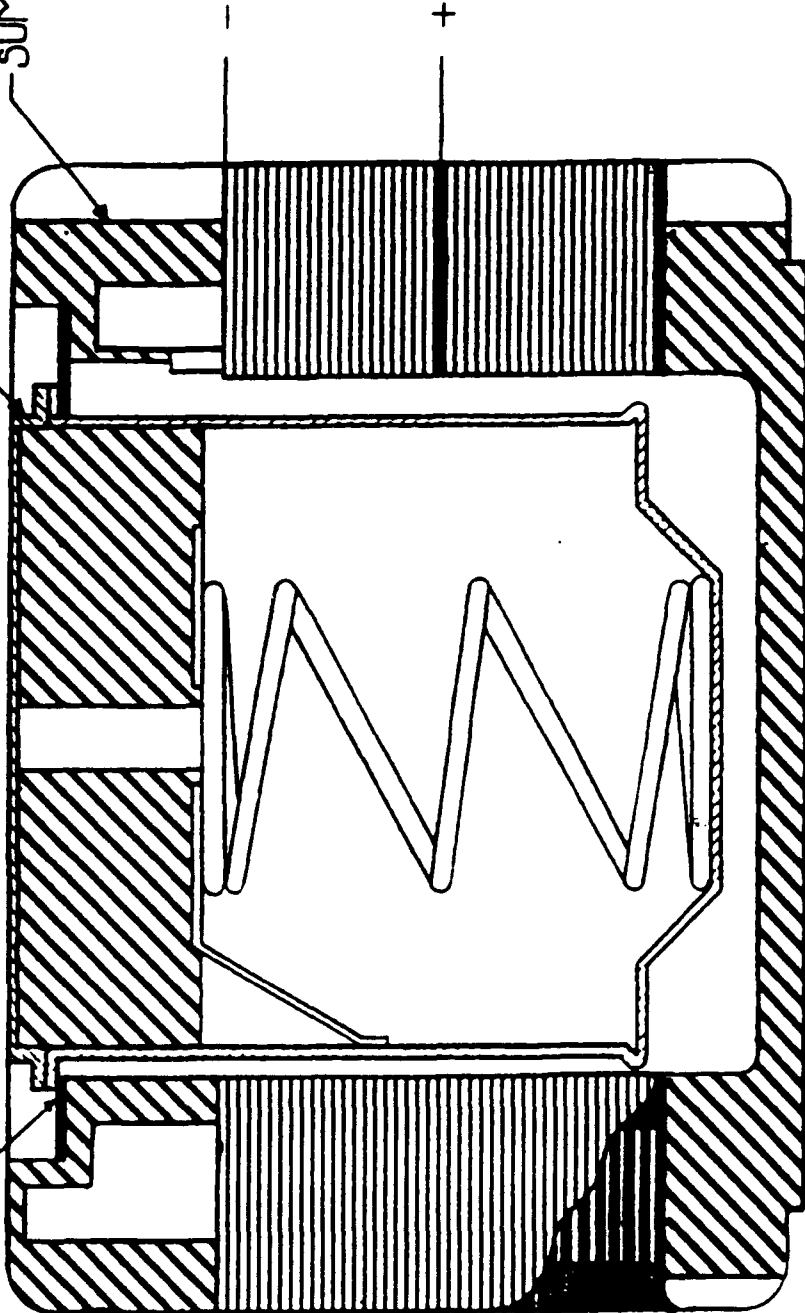
AMPULE SEAL

2 STACKS  
18 CELLS/STACK

SEAL RING

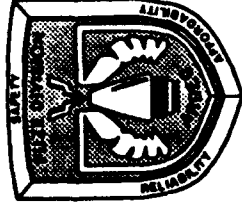
BASE

MK 43 MOD X



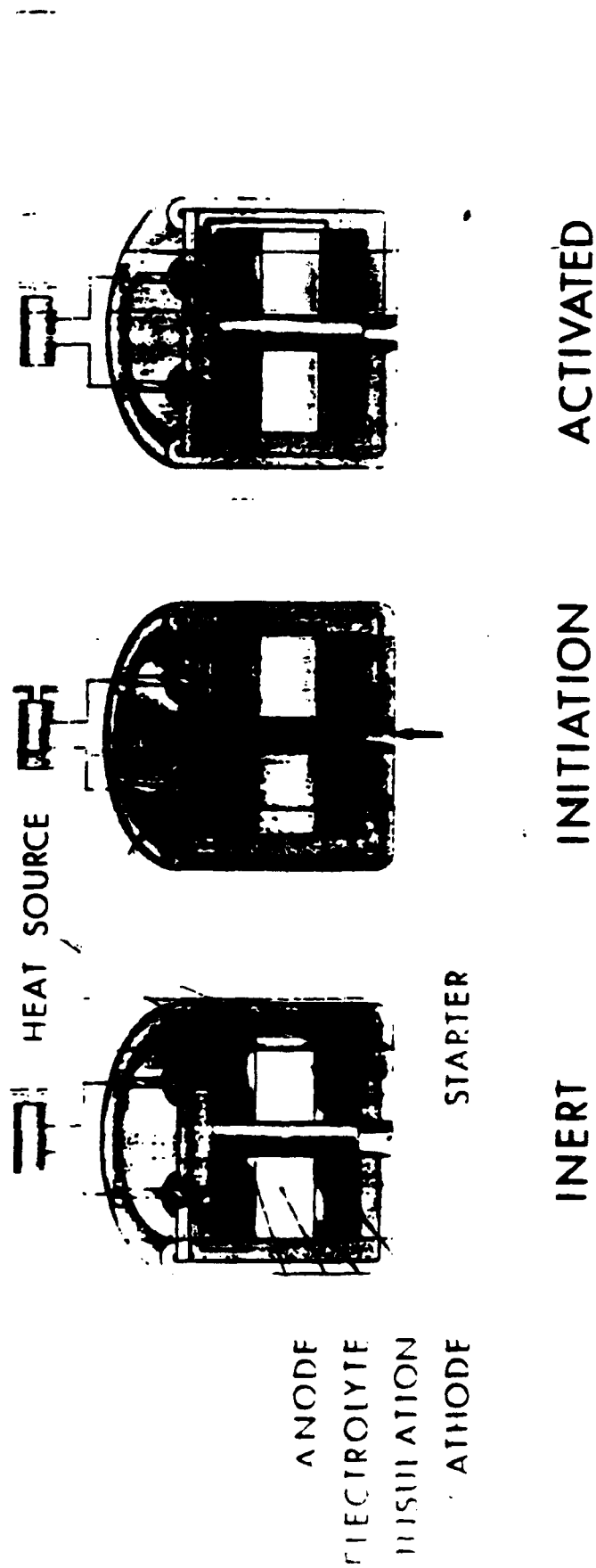


# Thermal Reserve Batteries



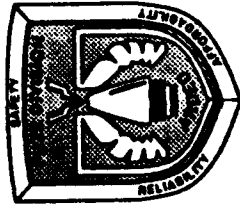
- 30+ Years Shelf-Life
- Solid Salt Electrolyte  
LiCl-KCl or LiBr-LiCl-LiF Eutectic  
Binder (Kaolin, SiO<sub>2</sub>, MgO)
- Various Electrochemistries
- Activation by Inertial Starter, Electrical Match,  
and/or Primer
- Heat Paper (28% Zn, 72% BaCrO<sub>4</sub> mixed with  
glass and Fiberfrax fibers) or  
Pellets (14-16% KClO<sub>4</sub>, balance Fe powder)

# SCHEMATIC THERMAL CELL





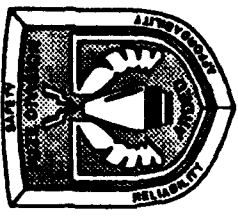
# **Growth Technology Areas for Fuze Applications**



- **Lithium Liquid Reserve Batteries**
- **Family of Reserve Batteries**
- **Spin Thermal Batteries**
- **Active Batteries**
- **Alternate Energy Sources**



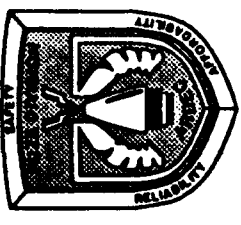
# **Lithium Liquid Reserve Batteries**



- No Significant Mech. Design Changes
- Electrode Material Widely Available
- Variety of Applications:  
Fuzing, Mines, Etc.
- Technical Challenges :  
Passivation, Hazards, Etc



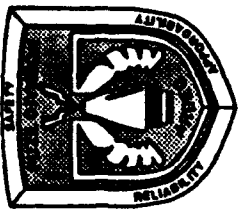
# Family of Reserve Batteries



- **Family of Batteries Versus Unique Battery for Each Application (Follows British Model):**
  - **Standard Range of Power/Size Batteries**
  - **Fuzes Designed to the Standard Battery**
- **Challenges :**
  - **Unknown Purchase Quantities**
  - **Identifying Family Members:**  
**size, voltage, power, energy**



# Spin Thermal Batteries

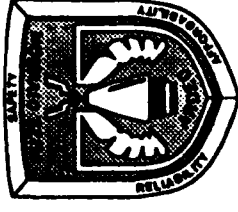


- **Started with Nuclear Artillery Fuze Program...**
  - **Current Application Ballistic Test in Fall '94**
- **Heat Management**
- **Cell Design**
- **Technical Challenges :**
  - **Heat Retention for Extended Range in Small Package**
  - **Mechanical Design to Contain Molten Salt at High Spin**





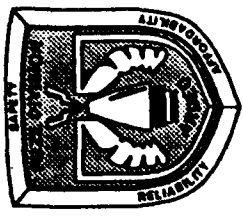
# Active Batteries



- Existing Broad Manufacturing Base
- Use Active Cells for Short-Term Mobilization
  - Successful SBIR Air Gun Test
- Technical Challenges :
  - Shelf Life (10+ Years)
  - Passivation (response time)



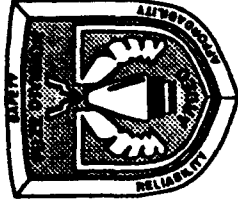
# **Alternate Energy Sources**



- **Capacitors (charged prelaunch)**
- **Piezoelectric (launch shock excited)**
- **Air Breathing Generators**
- **Vibration Converters**
- **Technical Challenges :**
  - **Cost & Volume Restrictions**
  - **Power Requirements**



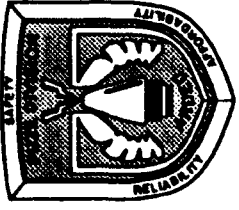
# Conclusion



- **Niche Market:**
  - Dependent on Weapon Procurements**
  - potentially large quantities**
  - Fuze is Sub-Component**
  - Power Supply is Sub-Sub-Component**
- **Shrinking Manufacturing Base:**
  - 1 Liquid Electrolyte (from 8)**
  - 1 Thermal (from 9)**



# **Army Cooperative R&D Agreement Opportunities**



## **ARMY RESEARCH LABORATORY POC:**

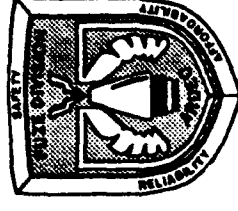
**Mike Claffy      (301) 394-3098**

## **FUZE POWER SUPPLY TECHNICAL POC:**

**Allan Goldberg      (301) 394-3114**



# **ARL BAA Opportunities**

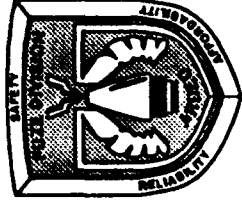


- **Solicitation #: DAAL01-95-R-ARL-BAA**
- **All Non-technical Questions:  
Ms. K. Wishnow  
(301) 394-3690**
- **All Technical Questions (on batteries):  
Mr. A. Ballato  
(908) 544-4308**



# **SBIR**

## **Business Opportunities**



- **DoD SBIR Solicitation:**  
**Defense Technical Information Center**  
**ATTN: DTIC/SBIR**  
**Building 5, Cameron Station**  
**Alexandria, VA 22304-6415**  
**(800) 225-3842**
- **ARL SBIR Information:**  
**Dean Hudson**  
**(301) 394-4808**

# NOTES

# **SMART MUNITIONS BATTERY REQUIREMENTS**

**MR. CLIFFORD D. SHOOK**

**CHIEF, MINES AND DISPENSER ELECTRONICS SECTION  
ARMAMENT RESEARCH, AND DEVELOPMENT CENTER  
TANK AUTOMOTIVE AND ARMAMENTS COMMAND**

**UNCLASSIFIED**



# **SMART MUNITIONS BATTERY REQUIREMENTS**

## **INTRODUCTION**

**SMART MUNITIONS ARE GUIDED TO A TARGET  
EITHER AUTONOMOUSLY OR WITH AN OPERATOR  
OR THEY SENSE A TARGET AND FIRE A WARHEAD.**

# **SMART MUNITIONS BATTERY REQUIREMENTS**

## **CONCERNS**

- **PRESENT RESERVE AND THERMAL BATTERY PRODUCERS ARE VERY LIMITED IN NUMBER.**
- **ONE PRODUCER HAS MOVED OFF-SHORE.**

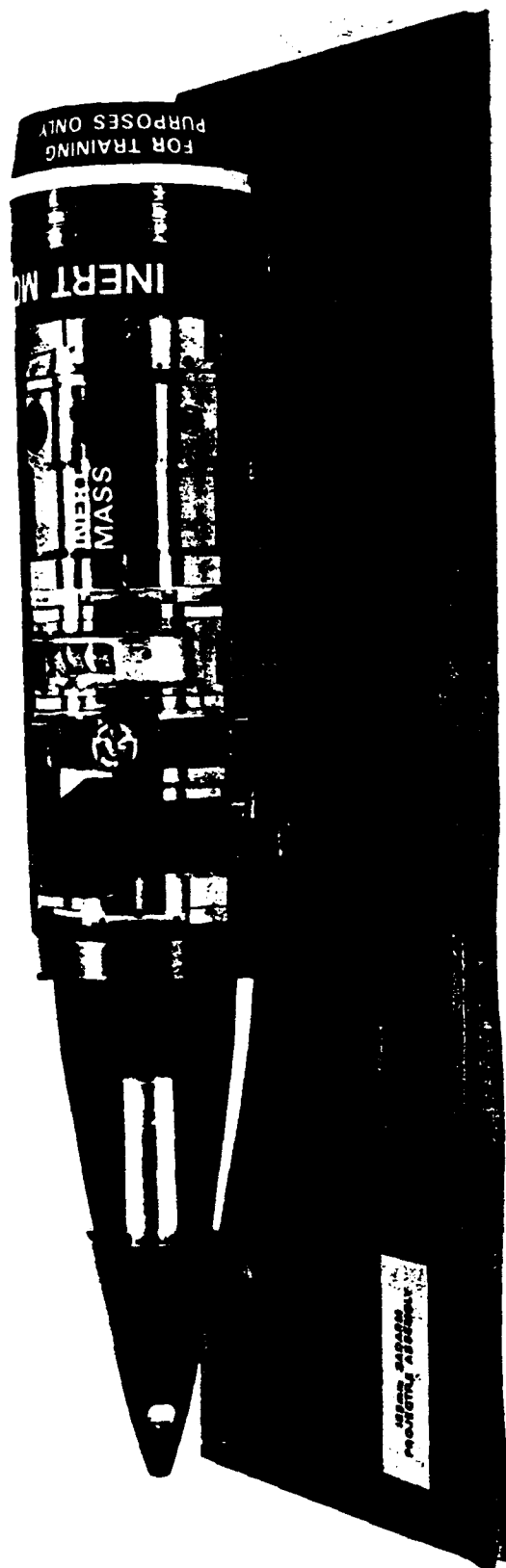
# **SMART MUNITIONS BATTERY REQUIREMENTS**

## **UNIQUE REQUIREMENTS**

- **WOODEN ROUND (NONREPLACEBLE / NONTESTABLE)**
- **STORAGE(UNPROTECTED) - 10 YEARS REQUIRED ; 20 YEARS DESIRED**
- **SURVIVE CANNON LAUNCH: 20K G's SETBACK, UP TO 240 RPS.**
- **HIGH RELIABILITY**
- **WORLD WIDE USE**
- **MINIMUM VOLUME**
- **HIGH POWER DENSITY**

# **SMART MUNITIONS BATTERY REQUIREMENTS**

**SADARM  
(SENSE AND DESTROY ARMOR)**



# **SMART MUNITIONS BATTERY REQUIREMENTS**

## **SADARM**

- **SENSE AND DESTROY ARMOR (SADARM)**
- **SADARM SUBMUNITIONS ARE DELIVERED TO AN AREA ABOVE THE TARGETS BY A VARIETY OF DELIVERY SYSTEMS. PRESENTLY, THESE DELIVERY SYSTEMS ARE THE 155 mm HOWITZER AND THE MULTIPLE LAUNCH ROCKET SYSTEM (MLRS).**

# **SMART MUNITIONS BATTERY REQUIREMENTS**

## **SADARM**

- **SADARM SUBMUNITIONS ARE DESIGNED TO AUTONOMOUSLY LOCATE AND DESTROY ENEMY STATIONARY ARMORED VEHICLES, PRINCIPALLY SELF PROPELLED HOWITZERS, FROM ALTITUDES OF 150 TO 300 METERS ABOVE THE TARGET AND AT RANGES OUT TO 30Km.**
- **SADARM SUBMUNITIONS ARE PRESENTLY IN THE FINAL STAGES OF ENGINEERING AND MANUFACTURING DEVELOPMENT.**

# **SMART MUNITIONS BATTERY REQUIREMENTS**

## **SADARM BATTERY**

- **THERMAL BATTERY (1.5 IN. D. X 1.25 IN. L)**
- **MINIMUM ACTIVE LIFE = 82 SECONDS**
- **VOLTAGE BETWEEN 7.5 VOLTS - 11.0 VOLTS**
- **CURRENT - 3.0 AMPERES FOR FIRST 47 SECONDS**
  - 6.0 AMPERES FOR REMAINING 35 SECONDS**  
**(3 AMPERE SURGE FOR 40 MILLISECONDS AT**  
**TRANSITION POINT).**
- **POC- MIKE SCHIKSNIS- COM: 201 - 724 - 4552.**



# **SMART MUNITIONS BATTERY REQUIREMENTS**

## **SADARM CONTRACT OPPORTUNITY**

- **LOW RATE INITIAL PRODUCTION IS SCHEDULED TO BEGIN IN FY95.**
- **SYSTEM FUNDING : TBD**
- **SYSTEM CONTRACT TO BE AWARDED.**
- **POC: HOWARD BRUNSVOLL, TELEPHONE: COM. 201-724-4044.**

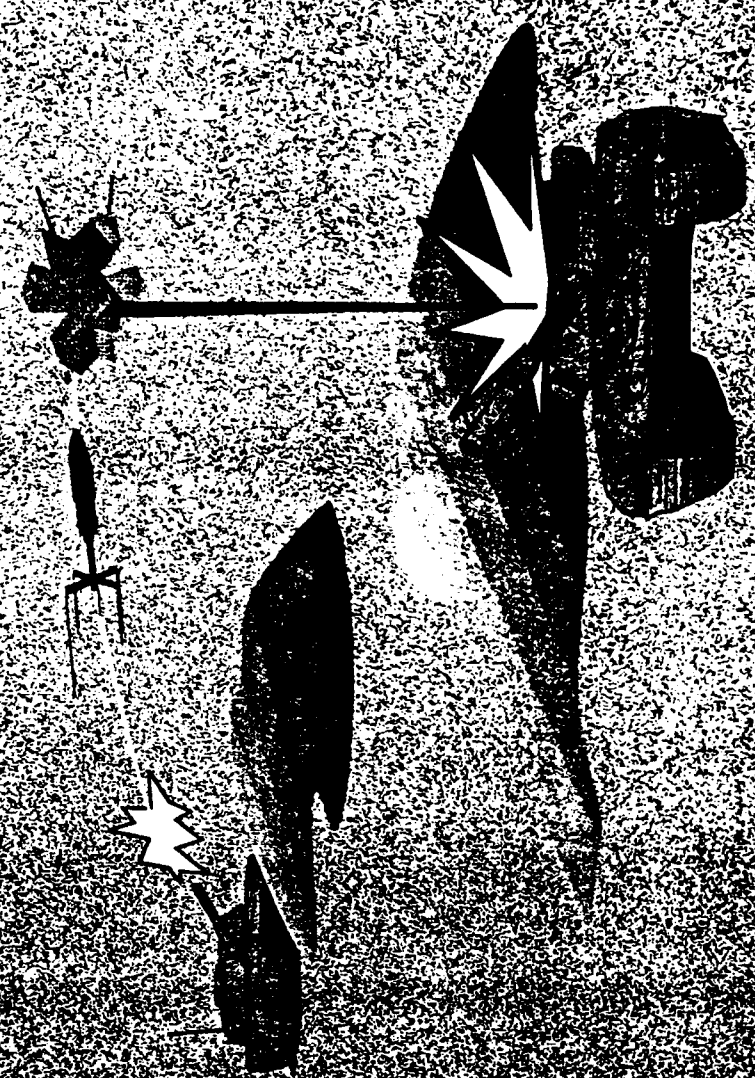
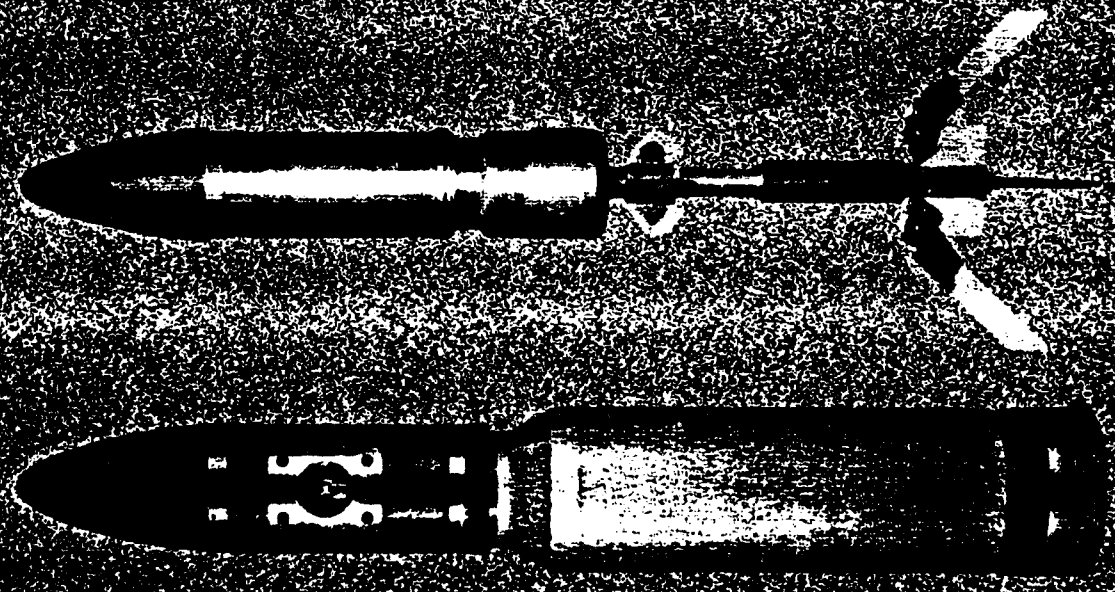
# **SMART MUNITIONS BATTERY REQUIREMENTS**

## **STAFF**

**(SMART TARGET ACTIVATED FIRE & FORGET)**

# Tank STAFF—XM 943

Status Update



# **SMART MUNITIONS BATTERY REQUIREMENTS**

## **STAFF**

- **SMART TARGET ACTIVATED FIRE & FORGET (STAFF)**
- **STAFF IS A 120mm TANK FIRED SMART ANTIARMOR PROJECTILE.**
- **STAFF USES A FORWARD LOOKING MILLIMETER WAVE (MMW) RADAR TO DETECT ARMORED GROUND VEHICLES OR HELICOPTERS. AFTER A TARGET IS DETECTED AND VALIDATED, DOWNWARD LOOKING RADAR IS USED TO ROLL THE LETHAL MECHANISM UNTIL IT IS POINTED AT THE TARGET. AS THE PROJECTILE PASSES OVER THE TARGET, AN EXPLOSIVELY FORMED PENETRATOR IS FIRED INTO THE TARGET.**
- **STAFF IS PRESENTLY IN ENGINEERING AND MANUFACTURING DEVELOPMENT.**

# SMART MUNITIONS BATTERY REQUIREMENTS

## STAFF BATTERY

- TWO(2) THERMAL BATTERIES: A= 1.63 IN.D. X 2.85 IN.L.  
B= 1.44 IN.D. X 2.25 IN.L.
- MINIMUM ACTIVE LIFE = BATT. A = 15 SEC, INOPERABLE IN 30 MIN.  
BATT. B = 11 SEC, INOPERABLE IN 30 MIN.
- VOLTAGE: BATT. A = 60 - 100 VOLTS.  
BATT. B = DUAL OUTPUT OF 10-25 VOLTS & 15-36 VOLTS.
- CURRENT: BATT. A = 2.0 AMPS NOMINAL WITH SURGES TO 40 AMPS  
BATT. B = UP TO 5 AMPS.(10-25V) & UP TO 7 AMPS.(15-36V).
- POC- GUS FLORIS- COM: 201 - 724 - 2829.

# **SMART MUNITIONS BATTERY REQUIREMENTS**

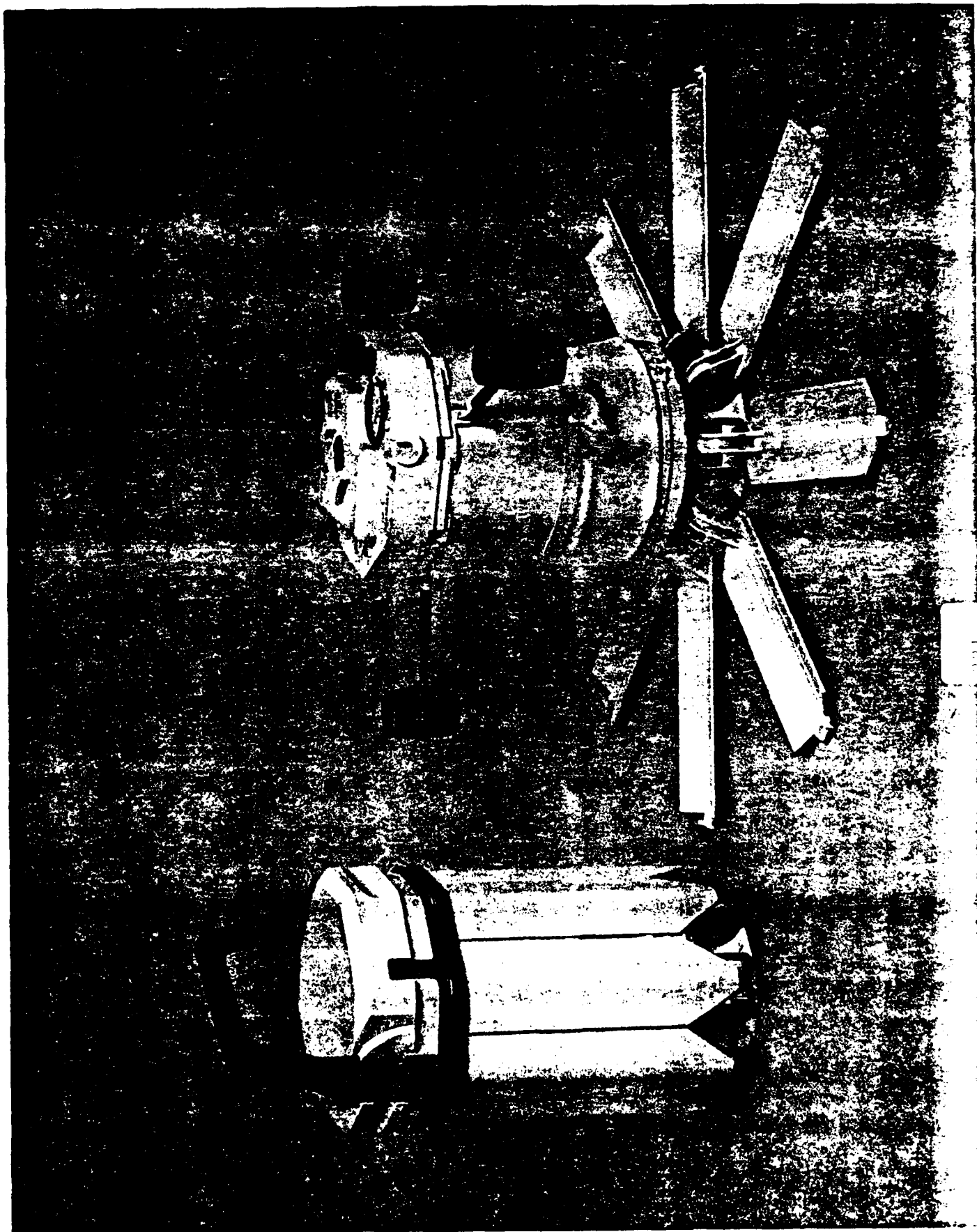
## **STAFF CONTRACT OPPORTUNITY**

- **STAFF SCHEDULE : CLASSIFIED**
- **SYSTEM CONTRACT**
- **POC: DAVID PANHORST, TELEPHONE : 201-724-7258.**

# **SMART MUNITIONS BATTERY REQUIREMENTS**

**WAM**

**(WIDE AREA MINE)**





# **SMART MUNITIONS BATTERY REQUIREMENTS**

## **WAM**

- **WIDE AREA MINE (WAM)**
- **WAM IS HAND EMPLACED ON THE GROUND AND AUTONOMOUSLY SEARCHES FOR THREAT VEHICLES USING ACOUSTIC AND SEISMIC SENSORS AT RANGES UP TO 100 METERS.**

# **SMART MUNITIONS BATTERY REQUIREMENTS**

## **WAM**

- **ONCE A TARGET IS LOCATED, A SMART SUBLET EQUIPPED WITH A SOPHISTICATED INFRARED SENSOR IS LAUNCHED OVER THE TARGET. THE TOP OF THE TARGET IS ATTACKED WITH A HIGHLY LETHAL EXPLOSIVELY FORMED PENETRATOR.**
- **THE WAM IS DEPLOYED BY A FOOT SOLDIER.**
- **WAM IS PRESENTLY IN ENGINEERING AND MANUFACTURING DEVELOPMENT.**

# **SMART MUNITIONS BATTERY REQUIREMENTS**

## **PRESENT WAM BATTERY**

- **LITHIUM THIONYL CHLORIDE RESERVE (3.95 IN. D. X 2.87 IN. L.)**
- **VOLTAGE: 8-15 VOLTS**
- **CAPACITY ( 400 ma DISCHARGE LOAD )**
  - 13 AMPERE-HOURS @ 145 F**
  - 14 AMPERE-HOURS @ 72 F**
  - 11 AMPERE-HOURS @ -25 F**
- **DEPASSIVATION PULSE REQUIRED.**
- **POC- ANGELO RUFRANO-COM: 201 - 724 - 6782.**

# **SMART MUNITIONS BATTERY REQUIREMENTS**

## **NEAR TERM WAM BATTERY**

- **LITHIUM COBALT DIOXIDE RESERVE ( 3.95 IN.D. X 2.87 IN.L.)**
- **RECHARGEABLE (10 CYCLES TO 80% INITIAL CAPACITY )**
- **VOLTAGE: 10 VOLTS MINIMUM**
- **CAPACITY: (400 ma DISCHARGE LOAD )  
17 AMPERE-HOURS @ 145 F, 72 F, AND -25 F.**
- **DEPASSIVATION PULSE NOT REQUIRED.**
- **POC: ANGELO RUFRANO - COM: 201 - 724 - 6782.**

# **SMART MUNITIONS BATTERY REQUIREMENTS**

## **FUTURE WAM BATTERY**

- **UNKNOWN / TBD CHEMISTRY RESERVE (3.95 IN.D. X 2.87 IN.L.)**
- **RECHARGEABLE ( 10 CYCLES TO 95% INITIAL CAPACITY )**
- **VOLTAGE: 10 VOLTS MINIMUM**
- **CAPACITY (400 ma DISCHARGE LOAD )  
25 AMPERE-HOURS @ 145 F,**
- **DEPASSIVATION PULSE NOT REQUIRED.**
- **POC- ANGELO RUFRANO-COM: 201 - 724 - 6782.**

# **SMART MUNITIONS BATTERY REQUIREMENTS**

## **WAM CONTRACT OPPORTUNITY**

- **WAM SCHEDULED FOR LRIP IN FY96  
- SYSTEM CONTRACT**
- **NEAR TERM BATTERY DEVELOPMENT EFFORT WILL BE  
ACCOMPLISHED THROUGH A GOVERNMENT CONTRACT  
OR THROUGH THE SYSTEM CONTRACTOR.  
- CONTACT AWARD TENTATIVELY SCHEDULED FOR  
FY95.**
- **FUTURE WAM BATTERY DEVELOPMENT TBD.**
- **POC: GEORGE LUTZ- TELEPHONE: COM. 201-724- 7848.**

# **SMART MUNITIONS BATTERY REQUIREMENTS**

## **OTHER SMART MUNITIONS**

- **PRECISION GUIDED MORTAR MUNITION (PGMM)**
  - DEMO PROGRAM USING GUIDED 81mm & 120mm MORTARS TO DEFEAT TARGETS.
- **X - ROD**
  - DEVELOP A 120 mm TANK FIRE & FORGET AUTONOMOUSLY GUIDED KINETIC ENERGY ROUND.
- **AUTONOMOUS INTELLIGENT SUBMUNITION (AIS)**
  - DEVELOP A TACTICAL SUBMUNITION WITH A WIDE SEARCH AREA AND CAPABLE OF MANEUVERING TO ATTACK TARGETS.
- **ARMICIDE - AIR DEFENSE WEAPON**
  - GUN LAUNCHED SMART MUNITION TO ATTACK ACTIVE RADARS.
- **BATTLEFIELD IMAGING PROJECTILE SYSTEMS (BIPS)**
  - CANNON LAUNCHED REAL TIME BATTLE ASSESSMENT SYSTEM.

# **SMART MUNITIONS BATTERY REQUIREMENTS**

## **SUMMARY**

- **SMART MUNITIONS GIVE THE ARMED FORCES THE ABILITY TO MAKE SURGICAL STRIKES AGAINST STRATEGIC AND TACTICAL TARGETS.**
- **SMART MUNITIONS REQUIRE A BATTERY THAT IS CAPABLE OF BEING STORED UP TO 20 YEARS IN THE MUNITION AND THEN FUNCTION RELIABLY WHEN USED.**
- **THE NUMBER OF BATTERY MANUFACTURERS FOR SMART MUNITIONS NEEDS TO BE INCREASED TO PROVIDE A STABLE BASE.**
- **FUTURE SMART MUNITIONS WILL REQUIRE BATTERIES WITH HIGHER POWER DENSITIES.**

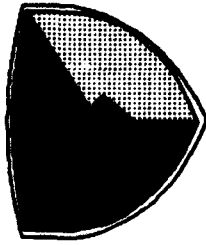


# NOTES

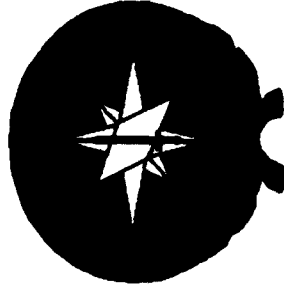
# **CLOSING REMARKS**

**Mr. Kenneth M. Morgan  
Director  
Systems Management  
CECOM**

AMC



# **SUMMARY**



- ▶ **REDUCE O&S COSTS**
- ▶ **IMPROVE PERFORMANCE**
- ▶ **ENVIRONMENTALLY FRIENDLY**
- ▶ **ARMY-WIDE TEAMING**
- ▶ **ENHANCE THE ROLE OF  
INDUSTRY**

# NOTES

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